MODERN PLASTICS

JANUARY 1955

PLASTICS PROGRESS AND PROSPECTS

QM* Floor Show directs the spotlight on *Catalin* Styrene

And in gracious acknowledgement, CATALIN STYRENE lauds the stars of the show . . . a profuse and richly colorful troupe of distinguished Planters, scientifically designed and produced by Quality Molding Co., a specialist in the field!

Certain too, is the forthcoming applause from America's amateur home-gardener. Florals entrusted to the care of these wick-fed or sub-irrigated receptacles are bound to thrive and endear themselves throughout the house! Weekly watering chores too, have turned glamourous. Note the new, leak-proof "QM Watering Pot." Were we to disclose its seemingly seamless assembly, you'd marvel at the progress being made in plastics.

Products molded of low cost CATALIN STYRENE, the gem of plastics, are fast becoming as much the favorites in home wares as they are in housewares. So, whenever you plan to project a new *ware* of your own, members of the Catalin service staff will welcome the opportunity to materially assist you.

**Products of Quality Molding Company
Chicago 39, Illinois*

CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE • NEW YORK 16, N. Y.

CATALIN

In addition to Styrene Molding Compounds, Catalin chemical products include a wide range of Urea, Phenolic, Cresylic, Resorcinol, Melamine and Styrene Resin formulations

MODERN PLASTICS*

January 1955 • Vol. 32 No. 5

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DEPARTMENTS

Modern Plastics, published monthly by Breskin Publications, Inc., at Emmett St., Bristol, Conn. Modern Plastics Encyclopedia Issue published as second issue in September by Plastics Catalogue Corp., at Emmett St., Bristol, Conn. Executive and Editorial Office: 575 Madison Ave., New York 22, N. Y. Entered as second class matter at the Post Office at Bristol, Conn., December 14, 1950, under the Act of March 3, 1879. Modern Plastics is regularly indexed in Industrial Arts Index and Industex. Subscription rates: U.S., its possessions, and Canada, $6.00 for one year, $11.00 for two years, $15.00 for three years; Pan-American countries, $8.00 for one year, $13.00 for two years, $17.00 for three years; all other countries $12.00 for one year, $20.00 for two years, $28.00 for three years, payable in U.S. currency. Single copies $0.75 each in the United States, its possessions, and Canada; all other countries, $1.25 (except the September Encyclopedia Issue, which is not sold separately). Printed in the U.S.A., by Hildreth Press, Inc., Bristol, Conn.

* Reg. U.S. Pat. Office.

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EDITORIAL

A Report and a Promise

At this time, when it is customary to review the work of the past year and firm up plans for the new year, the editors of Modern Plastics are pleased to report that in 1954 we presented 1023 pages of reading matter in the 12 monthly issues of the magazine, aside from the Modern Plastics Encyclopedia Issue. This editorial material was background for approximately 2150 pages of advertising.

On matters generally of interest to most of our readers, the General Section carried over 472 pages of reading matter.

The Plastics Engineering Section, including discussion and illustration of new equipment, ran 150 pages over the year.

The Technical Section, embracing detailed papers on new phases of plastics technology, and embracing also patents and digests of the world's literature on plastics, used 180 pages in 1954. Reviews of new books and booklets on plastics took 40 pages.

The Plasticope, which contains the latest information on materials availability, trends in the industry, and news, ran 120 pages. And finally 12 pages were devoted to the statistical presentation of plastics production and sales from month to month. The difference between the total of these sections and the total number of reading pages for 1954 is made up of editorial and contents pages, covers, and incidental columns.

Modern Plastics differs from other industrial magazines chiefly in the spirit and the method with which its editors approach the problems and the interests of its readers. All articles, whether involving contributed material or not, are very closely edited. We select each item, each illustration from the criterion of its probable importance to the greatest number of our readers.

The 1023 pages of reading matter in Modern Plastics Magazine last year represented about 70,000 miles of travel by its editors, some 55 man-days at conventions, over 500 field interviews, and vast quantities of correspondence.

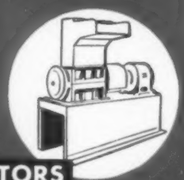
In addition, the editors of Modern Plastics spoke from 20 platforms, sat in at a score of industry committee meetings. The Readers Service Department, plus the editors personally, provided answers to almost 20,000 reader inquiries.

We are proud of the fact that Modern Plastics was not "scooped" anywhere on a single important development in plastics, plastics processing, or plastics application. Indeed, our editors were often told by interviewees, "You're too early!", when a story was being developed. But we got the information and we printed it—first in the fields related to plastics.

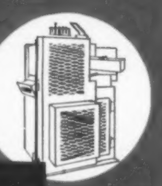
In 1955 this enthusiasm-seasoned work will continue, but with improvements. A comparison of the format and presentation of information in the issue to hand with that of January 1954, will illustrate the point.

Our promise for 1955 is this: a) more useable information, even more thoroughly researched; b) tighter editing for quicker perception; c) more highlighting of essential factors; d) more dramatic and animated presentation of chart and statistical material; e) more attention to business interpretation of industrial developments in plastics; f) the same sincere devotion to the interests of our readers that has always been the mark of Modern Plastics.

In Plastics Reducing Machinery, Look to CUMBERLAND for the COMPLETE LINE



GRANULATORS



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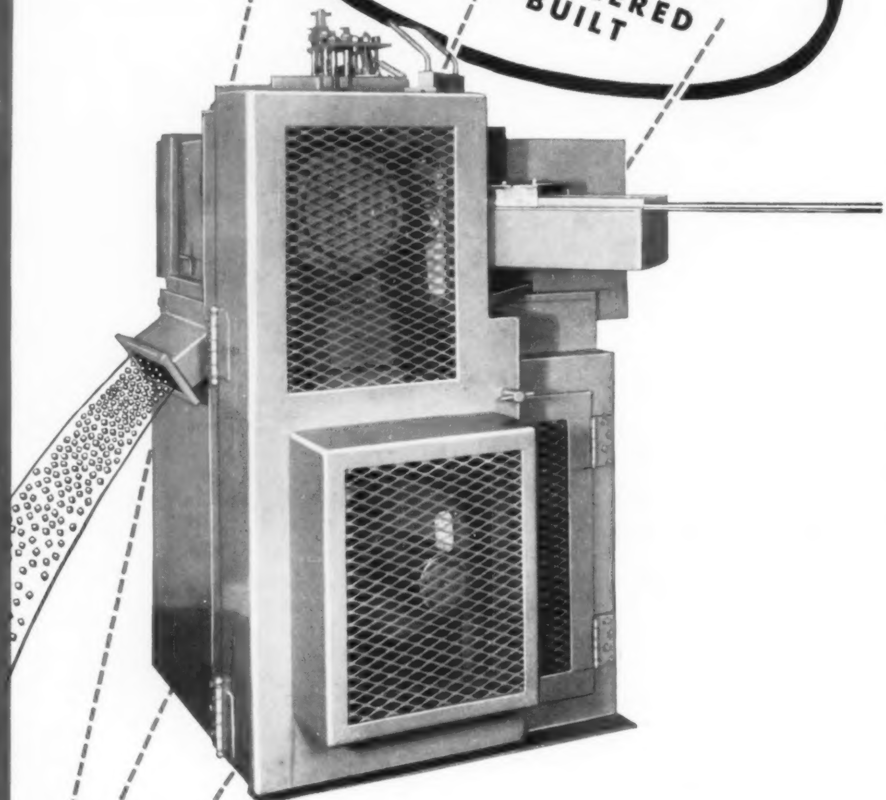

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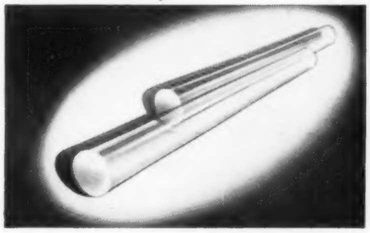

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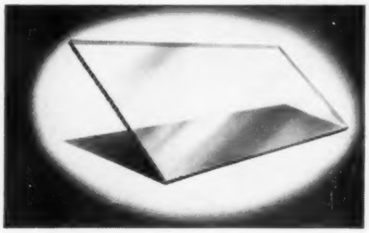
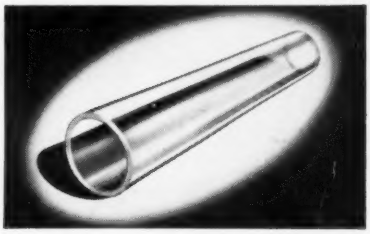


TUBES



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. . . manufacturing facilities assure an adequate supply of this most versatile of thermoplastic materials. "Cadco" cast acrylic rods and tubes are optically clear, easily machined for a wide range of decorative and utilitarian applications. Sizes up to 12 inches in diameter and ½ inch wall thickness. "Cadco" has high lustre qualities and is available in a variety of pearlescent colors.

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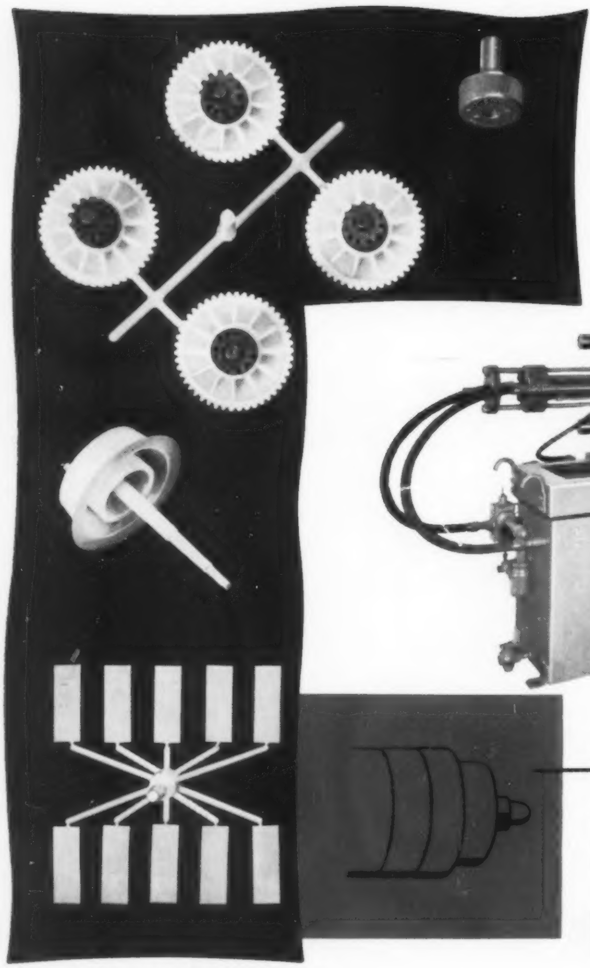
MORE MOLDERS USE
"REEDS"

Nylon Molding?
...here's .002" tolerance work, fast cycling, on the "REED" 175T-4/6 oz.

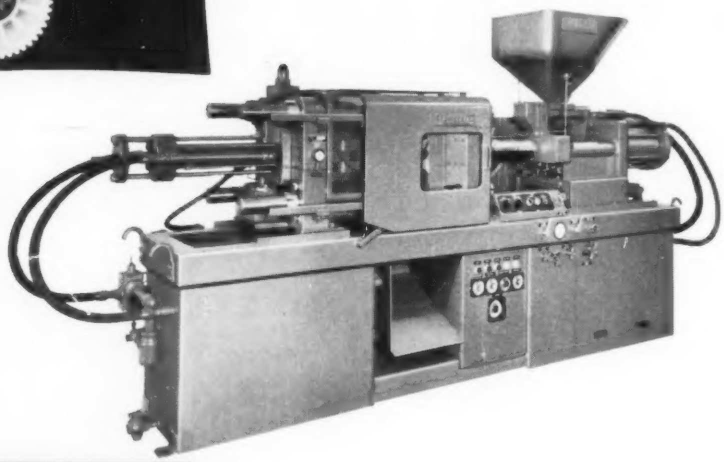
The nylon molded products shown here — the threads in the knob; the gears; the spool, a one-cavity shot; and the lenses — all these are held to tolerances of .002" on the 175T-4/6 oz. "REED" Production cycles are as low as 19 seconds . . . finished nylon parts completely uniform and of high quality.

This close tolerance high speed production is the result of the high plasticizing capacity and the positive mechanical locking action built into all "REEDS"

Good reasons why more molders use "REEDS" than any other Plastic Injection Molding Machine.



Products molded by: Westplex Corp., Rochester, N.Y. and Molding Specialists, Inc., Yonkers, N.Y.



Special "Nylon Nozzle" ends drool . . . whether virgin or reground nylon is used.

The special nozzle shown here handles reground or virgin nylon with equal facility — gives you full-time production without drool. Requires no special shut-off attachment.

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Handles of "**LUCITE**" enhance the appearance of lavatory fixtures made by Crane Company.

4 more examples product

Laboratory ware of "**ALATHON**" is lightweight, unbreakable, and has outstanding chemical resistance.

When you are looking for a new design – or a way to improve a product or process – consider the Du Pont family of engineering materials. These case histories below may suggest new design ideas for *your* product.

"LUCITE"* acrylic resin has become more and more popular for a great variety of household items. Here "Lucite" has been molded into handles used on Crane lavatory fixtures. Soaps, detergents and water won't affect their clarity. "Lucite" also resists shattering, chipping and crazing. (Lavatory handles molded for the Crane Company, Chicago, by Keolyn Plastics, Chicago, Illinois.)

"TEFLON"* tetrafluoroethylene resin is used for the insulation of these electronic connectors. Its uniform dielectric constant of 2.0 in the frequency range of 60 to 10^9 cycles insures that the connectors have a constant 50-ohm impedance. The high volume resistivity of 10^{15} ohms cm. and low power factor of .0002 enable the connectors to carry RF power with practically no insertion loss. "Teflon" has zero water absorption and excellent resistance to temperature extremes. (Connectors manufactured by Industrial Products Company Division of Danbury-Knudsen, Inc., Danbury, Conn.)

"ZYTEL"† nylon resin has solved a vibration problem for the Remington Stud Driver. The driver uses the

"TEFLON" provides this connector with remarkable insulating and physical properties.

# of advanced engineering

"ZYTEL" damps vibration, solving a problem for the manufacturers of this stud driver.

power of a 32 caliber cartridge to drive studs into structural steel and concrete. Repeated firing tended to loosen the housing screws and disc retainer—affecting the firm positioning of the housing assembly. To correct this condition, inserts of "Zytel" nylon were put in the eight housing screws and a washer of "Zytel" in the disc retainer. "Zytel" absorbs vibration . . . eliminates the nuisance of constantly retightening or replacing the housing screws by locking them tight. The rugged washer of "Zytel," inserted between the disc retainer and action tube, locks the retainer securely in position. (Manufactured by Remington Arms Company, Inc., Bridgeport, Connecticut.)

"ALATHON"* polyethylene resin improves performance for this laboratory ware. Equipment breakage is eliminated. They are lighter in weight and less slippery than glass. "Alathon" has outstanding resistance to corrosion and chemicals. A full line of laboratory items—including a faster-filtering funnel and cylinders with molded-in graduations—is expected to be on the market soon. (Molded by Pioneer Plastics, Dayton, Ohio.)

Investigate the properties of the Du Pont family of engineering materials. For further information on their properties and uses of these materials, clip the coupon or write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 301, Du Pont Building, Wilmington 98, Delaware.

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†"Zytel" is the new trade-mark for Du Pont nylon resin.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 301, Du Pont Building, Wilmington 98, Delaware.

Please send me more information on the Du Pont engineering materials checked: ☐ "Teflon" tetrafluoroethylene resin; ☐ "Lucite" acrylic resin; ☐ "Alathon" polyethylene resin; ☐ "Zytel" nylon resin. I am interested in evaluating these materials for

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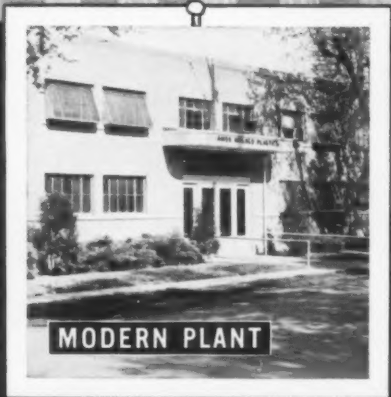
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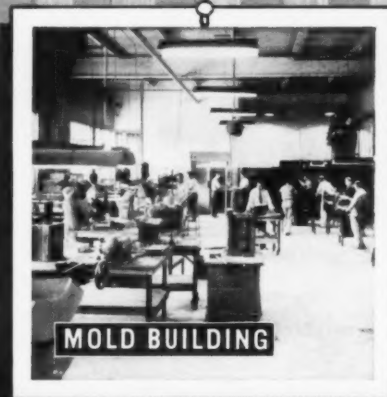
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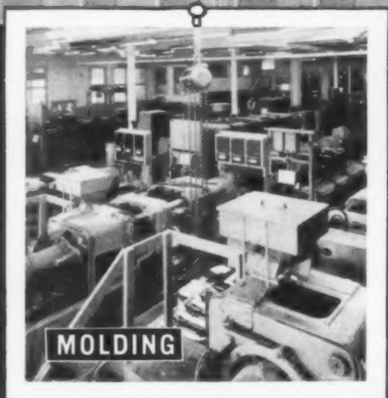
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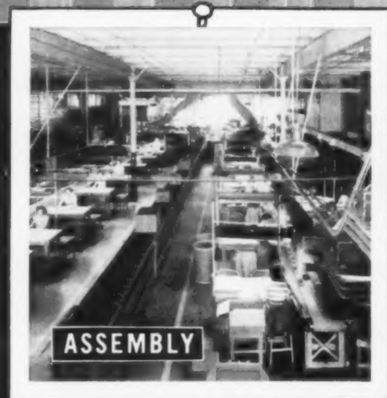
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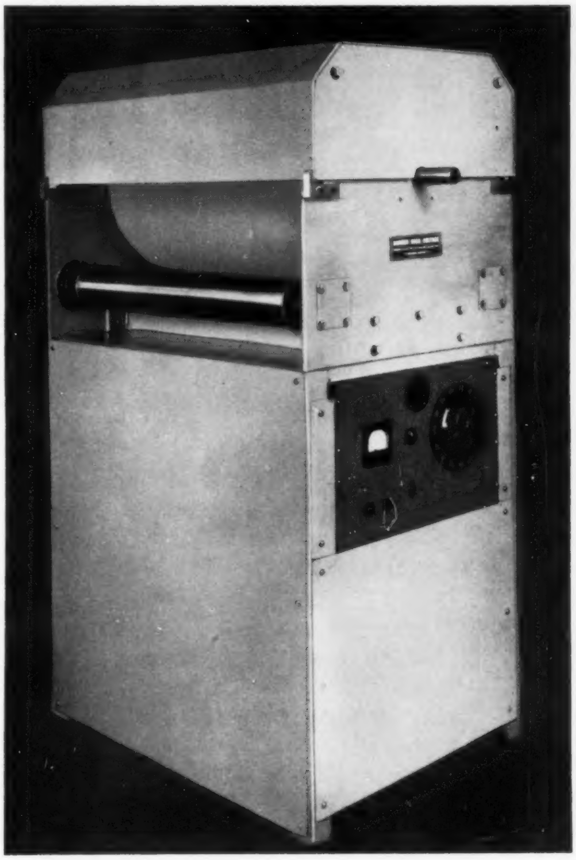
FINISHING

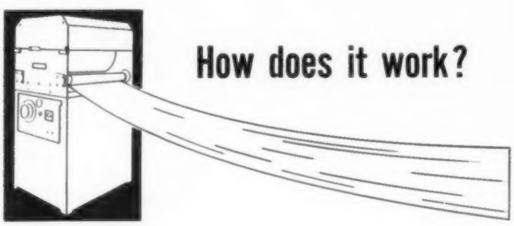
This unit is all you need to make *Polyethylene Printable*

It's the MPM-Traver unit. It's electronic. It's simple to operate. It applies the most advanced technique yet designed to give polyethylene film a surface that readily accepts printing.

What are the main features of the MPM-Traver unit? Well, it's a compact unit, low in operating costs and high in versatility. You can install the unit on the extruder's take-up for efficient in-line operation, or set it up elsewhere in your plant where treatment is handled separately. The unit will process any gauge or width material, without altering finish or dimensions, without changing major characteristics.

Electronic bombardment of material, as incorporated in the MPM-Traver unit, means processing without open flame, dangerous heat, or cooling problems. It means control of the treatment for uniformity of printing quality across the roll. The MPM-Traver unit is extremely safe to operate because it's interlocked for operator safety, and current automatically cuts off when threading film.





How does it work?

Material is fed either from a roll or directly from the extruder. As it passes through the unit, electronic bombardment occurs. This process is controllable by the operator to secure the degree of treatment desired. After treatment, the material is taken up on a roll where it is ready to accept printing at any subsequent time.

Modern Plastic Machinery Corp. holds exclusive manufacturing rights to this new development. For more detailed information, or to make arrangements for a demonstration, call or write today.

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ELECTRICALLY INTERCHANGEABLE

and it dry blends, too—new PLIOVIC EDB90V

HERE'S electrifying news for wire coverers and other users of vinyl resins in applications where insulative properties are important. It's PLIOVIC EDB90V—the first of Goodyear's new series of electrical grade resins approved on an interchangeability basis.

PLIOVIC EDB90V is a straight polyvinyl chloride resin. But it's tailor-made with three specific aims in mind. The first is to give you a resin of approved electrical quality. The second is to give you a resin that is truly easy to extrude using a dry blend process. The third is to give you both these advantages with no sacrifice in physical properties.

PLIOVIC EDB90V easily passes the tests required by Underwriters' Laboratories, Inc., including the T and TW Building Wire Specifications and the 80°C. and 105°C. Appliance Wire Specifications. It is fully interchangeable with all other approved electrical grade vinyl resins. It dry blends readily into a smooth, free-flowing mix. It extrudes and calenders well. And it possesses excellent physical properties.

The primary reason for the unique combination of properties in PLIOVIC EDB90V is careful polymerization. Particular attention is paid to the close control of molecular weight and particle size, shape and distribution. Extra effort also is exerted to eliminate impurities. This is the same care and control that characterize the production of all PLIOVIC resins, developed to a much finer degree.

PLIOVIC EDB90V is new, but not untried. It has been fully proved—and approved—in exhaustive tests and trial plant runs. Why not prove it in your plant? Samples and top technical help on it and other new, electrical grade resins are yours by writing to:

Goodyear, Chemical Division, Akron 16, Ohio

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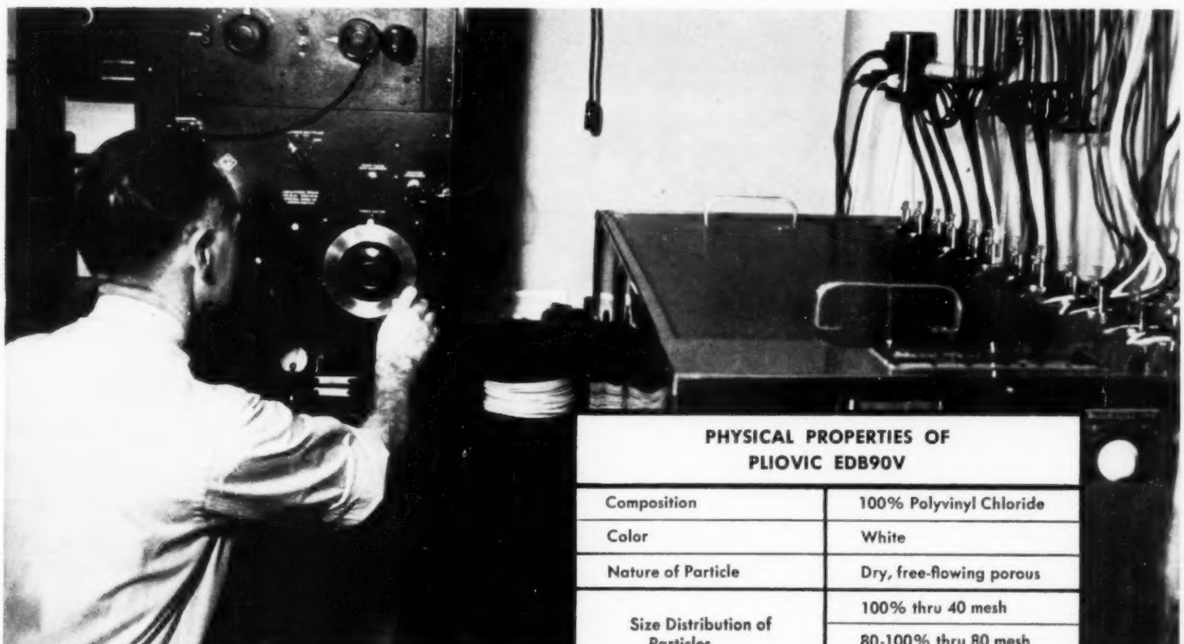
PLIOVIC EDB90V successfully passed rigorous tests such as these — Insulation Resistance Test (above) and Dielectric Constant Test (below)—to be declared fully interchangeable with all other approved, electrical grade, vinyl resins by Underwriters' Laboratories, Inc.



PHYSICAL PROPERTIES OF PLIOVIC EDB90V

Composition	100% Polyvinyl Chloride
Color	White
Nature of Particle	Dry, free-flowing porous
Size Distribution of Particles	100% thru 40 mesh
	80-100% thru 80 mesh
	0-15% thru 200 mesh
Intrinsic Viscosity	0.90 Av.
Specific Gravity	1.40 Av.
Bulk Density	38 lbs./cu. ft. av.
Volume Resistivity	2×10^{13} ohm centimeters (av.)

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I say, somebody goofed!

Look here, Holmes, something's amiss! These two molded units look exactly alike, yet how do you explain the price differential?

Hmm, we'll have to look into this, Watson! I'm going to ring up our good friends, Boonton. I'm certain they can solve this mystery. . . . I say, Boont, old fellow, are you there? Holmes here. Watson and I are stymied on this problem; be a good chap and help us out, eh what?

Sure, Sher, glad to be of assistance. Now, take the unit on the right. The manufacturer of that product demands ultra-close tolerances, ± .001″ to be exact. To apply and maintain such close tolerances, his molder must use costlier production methods, constant intricate supervision, highly expensive tooling, and slower production. Rejects run high. Why? Because even the slightest deviation means a piece is not acceptable. That's where the higher price comes in.

Now, let's look at the other unit. It is just as perfect, just as usable, just as attractive. But this customer allows his molder a little more latitude. The price reflects it.

Both units will do the same job with equal efficiency, but because one manufacturer set his tolerance "specs" abnormally close, the price he pays is abnormally high.

How's that, Sher? Does that answer your query?

Righto, Boont, jolly good of you to help . . . cheerio!

BOONTON MOLDING CO.

BOONTON, NEW JERSEY

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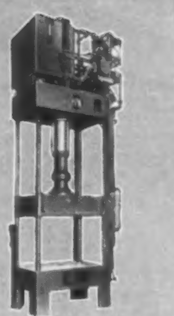
FULL HYDRAULIC CLAMP • PLENTY DAYLIGHT & STROKE

All New HPM

ACCESSIBLE POWER UNIT • HIGH SPEED INJECTION • BIG PLATENS



A complete line of stock presses from 50 to 200 tons, designed specifically for molding reinforced plastics. Larger sizes built to order.

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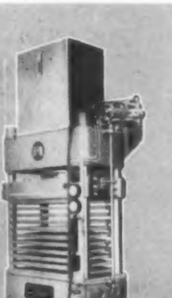

● Multiple hot plate presses with steam or electrically heated plates for compressing or curing laminated materials. Built to customer's requirements.

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Each machine is NEW . . . designed with so many outstanding improvements that even the most experienced injection molder will be amazed. Talk to an H-P-M plastics engineer today!

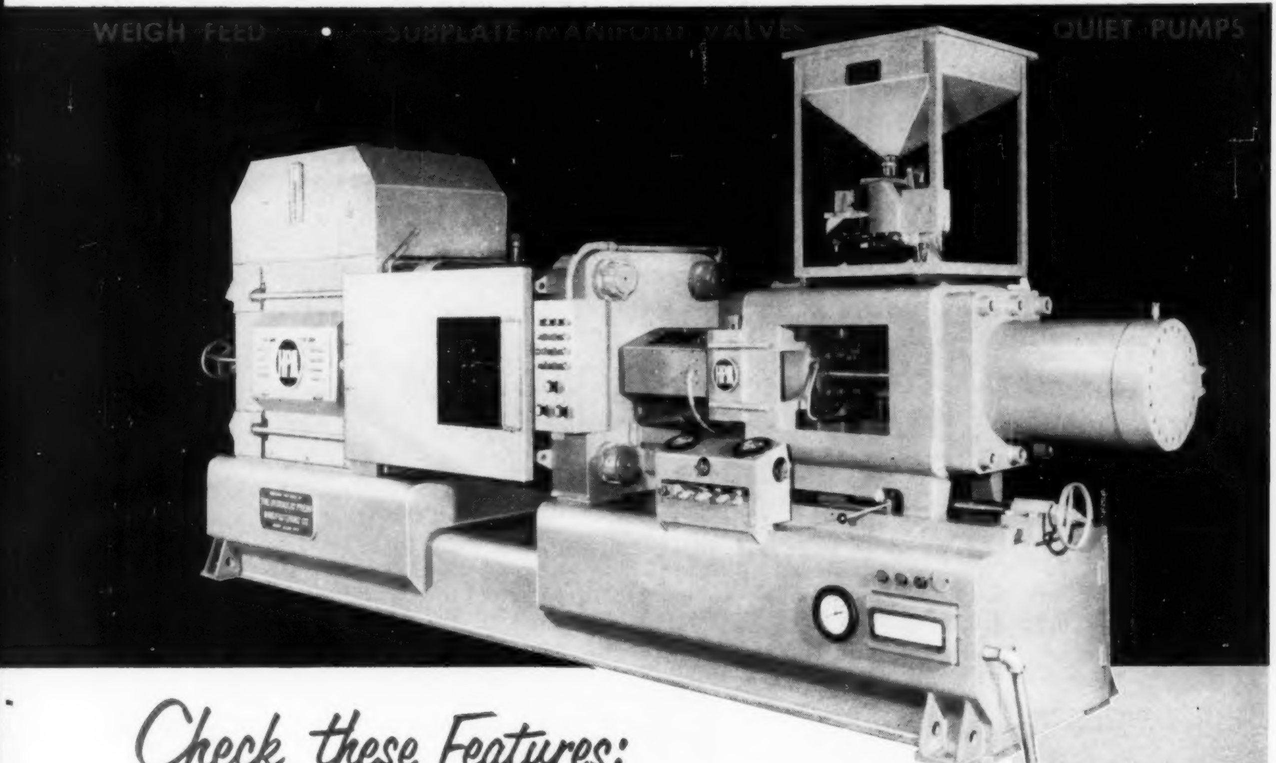
SPECIFICATIONS — STANDARD INJECTION MACHINES

MODEL NUMBER	150-H-6	300-H-12	400-H-20	800-H-48	1200-H-80
Capacity (Oz.—Single Feed)	6	12	20	48	80
Capacity (Oz.—Double Feed)	8	16	28	64	100
Material Injected (cu. in. per min.)	440	1035	1330	2895	2850
Plasticizing Capacity (lbs. per hr.)	80	135	200	350	400
Mold Clamp Capacity (tons)	150	300	400	800	1200
Mold Space (hor. x vert.):					
(a) Full Platen Vertically	10½"x25"	16½"x33"	20½"x 42"	36"x54"	40"x68"
(b) Full Platen Horizontally	20½"x15"	30"x20"	36"x26½"	54"x36"	60"x48"
Daylight Opening without Ram Spacer	20"	30"	40"	55"	60"
Daylight Opening with Ram Spacer	16"	26"	34"	47"	48"
Mold Thickness without Ram Spacer	10"	10"	15"	20"	24"
Mold Thickness with Ram Spacer	6"	6"	9"	12"	12"
Clamp Travel (max.)	10"	20"	25"	35"	36"
Motor Horsepower	20	40	50	100	100
Shipping Weight (pounds)	14,500	22,000	39,000	75,000	125,000

NOTE: All ratings based on molding general purpose polystyrene.

Write for Bulletin #5406 Today!

THERE'S AN H-P-M TO MOLD IT—



Check these Features:

FULL HYDRAULIC MOLD CLAMP — provides fast closing and opening speeds with automatic adjustable slow downs. No adjustments required for different mold thicknesses, which mean big savings in mold set-up time.

EXTRA-LARGE PLATENS — will accommodate big molds . . . located at ideal operator height, requiring no platforms or pits.

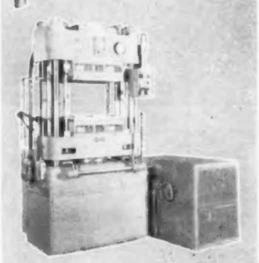
ACCURATE, COMPENSATING WEIGH FEEDER — is standard equipment on all conventional, large capacity models.

PLENTY DAYLIGHT & STROKE — permit production of deep parts. Quick changing ram spacer permits use of thin molds without bolsters.

OVERHEAD OIL TANK — keeps oil clean and provides gravity prefill for fast clamp pressure build-up.

HIGH-SPEED INJECTION UNIT — combines new high-output, 3-zone plasticizing chamber with injection plunger speeds over 50% faster than on previous models. Entire injection unit can be retracted hydraulically.

NEW H-P-M HYDRAULIC CIRCUIT — employs exceptionally quiet pumps and a new leakproof manifold sub-plate valve system which reduces hydraulic piping to a minimum.



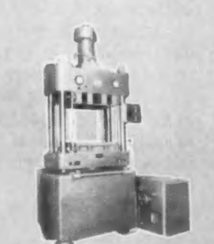
● Stock sizes 100, 200, 300 and 500 tons. Larger sizes up to 2500 tons built on special order.

Write for Bulletin No. 4901I

PRE-PLASTICIZING INJECTION MACHINES

MODEL NUMBER	400-P-48A	1200-P-200	1200-P-200A	3000-P-200A	3000-P-400A
Capacity (Oz.—Single Feed)	48	200	200	200	400
Capacity (Oz.—Double Feed)					
Material Injected (cu. in. per min.)	1340	6950	3000	6950	7200
Plasticizing Capacity (lbs. per hr.)	180	400	400	600	600
Mold Clamp Capacity (tons)	400	1200	1200	3000	3000
Mold Space (hor. x vert.):					
(a) Full Platen Vertically	21½"x 40"	40"x68½"	40"x68½"	49"x88"	49"x88"
(b) Full Platen Horizontally	36"x25½"	60½"x 48"	60½"x 48"	49"x88"	49"x88"
Daylight Opening without Ram Spacer	54"	60"	60"	60"	108"
Daylight Opening with Ram Spacer	46"	48"	48"	48"	84"
Mold Thickness without Ram Spacer	24"	24"	24"	30"	48"
Mold Thickness with Ram Spacer	16"	12"	12"	18"	24"
Clamp Travel (max.)	30"	36"	36"	30"	60"
Motor Horsepower	50	355	175	355	355
Shipping Weight (pounds)	46,000	154,000	143,000	264,300	324,300

NOTE: All ratings based on molding general purpose polystyrene.

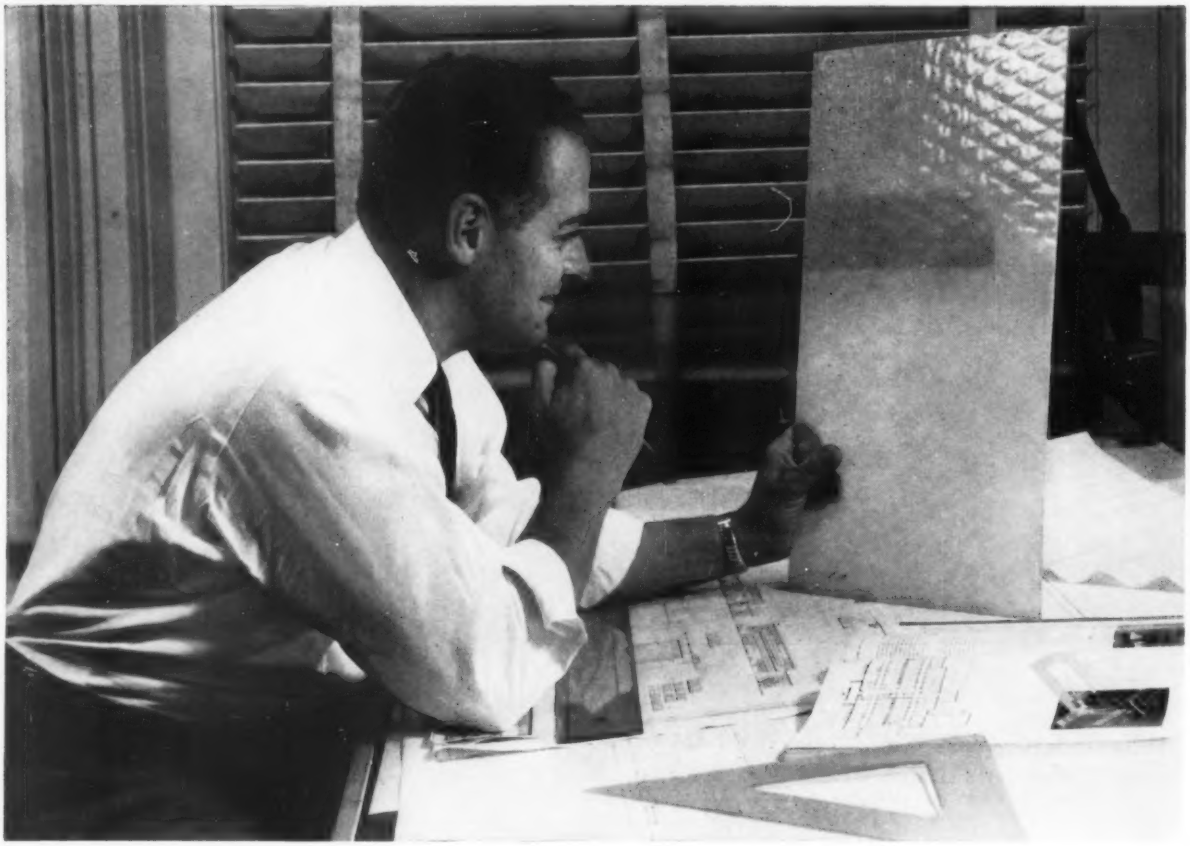


● Stock sizes 100, 200, 300 and 500 tons. Larger sizes up to 2500 tons built on special order.

Write for Bulletin No. 4901I

THE HYDRAULIC PRESS MFG. COMPANY
1010 Marion Road, Mount Gilead, Ohio, U. S. A.
Cable Address—"HYDRAULIC"

Better . . . Faster . . . and at Lower Cost!



Now you can get polyester laminates with ***specific flame resistance***

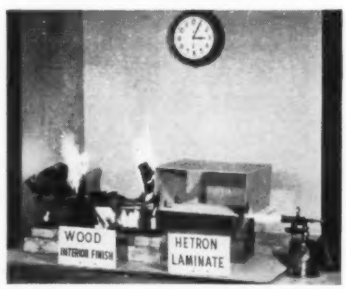
If it is an application where you can use the structural strength or the style imparted by modern glass-reinforced polyester sheets . . . but need *permanent, specific fire resistance* . . . ask your fabricator or molder for laminates made with HETRON® polyester resin.

HETRON's flame resistance, which distinguishes it from virtually all other resins, is chemically locked in. The result is unique stability. There is no loss of mechanical properties, as may occur when flame resistance is obtained through the use of additives alone.

HETRON resins have the added advantages of high chemical resistance, shrinkage on cure averaging 5%, a heat distortion point of 220° F. for HETRON 92, and water absorption for the same material of 0.26% after 7 days' immersion at 73° F.

In short, HETRON resins offer you all the advantages of a good polyester material—easy moldability, machinability, and adaptability—*plus* the fact that they are self-extinguishing.

We supply the resins only, but will be glad to send you names of molders and fabricators who make HETRON-based sheets. Write also for technical data and specifications on HETRON resins.



FLAME TEST proves sheet made with HETRON polyester resin does not burn freely with exposure to blowtorch flame. Veneered wood, used as basis of comparison, ignites from candle flame and burns to destruction in five minutes.

HOOKER CHEMICALS

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

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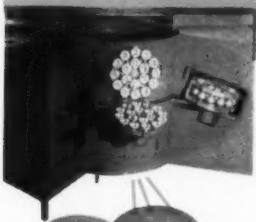
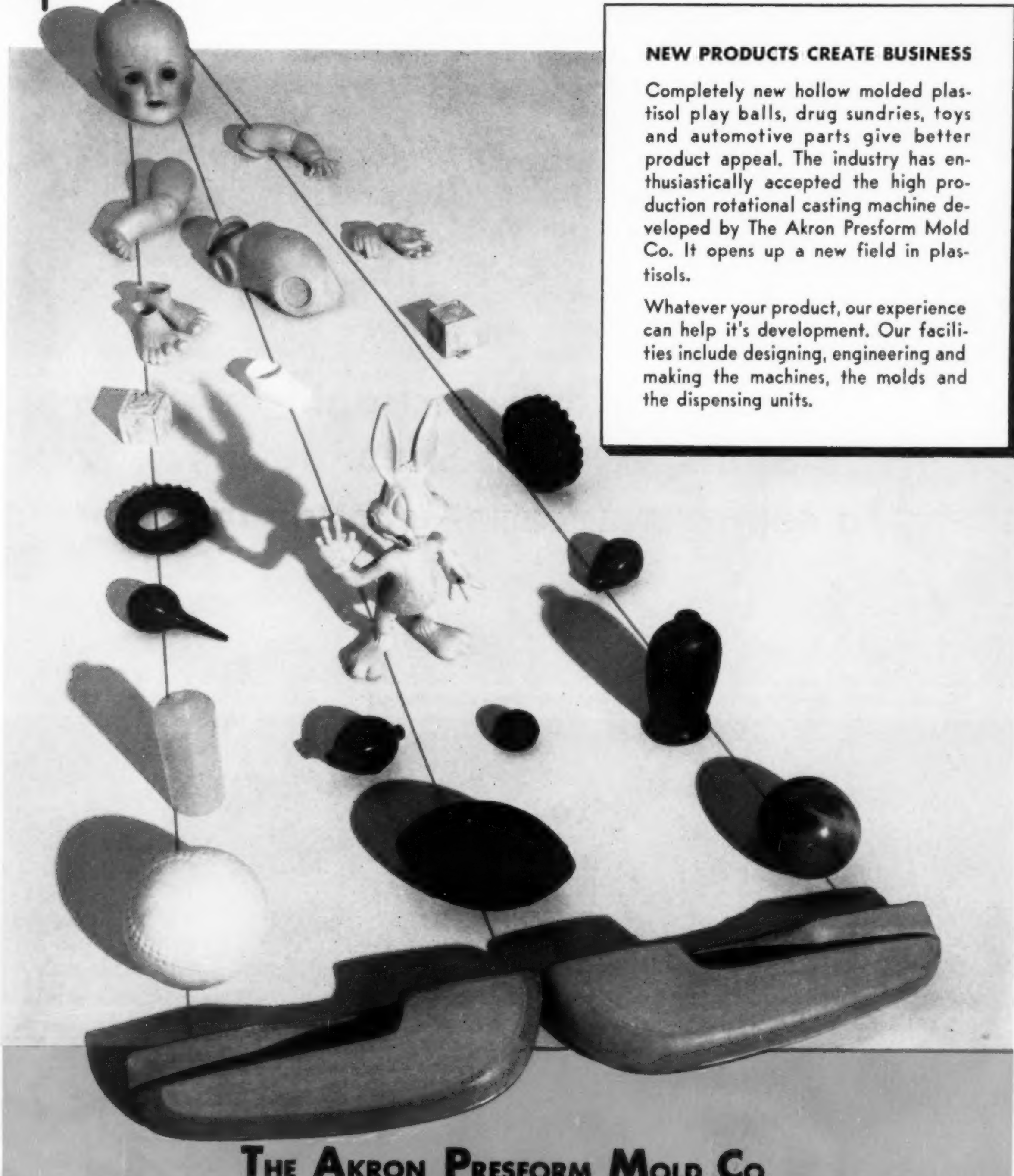


ROTATIONAL CASTING OF PLASTISOLS



NEW PRODUCTS CREATE BUSINESS

Completely new hollow molded plastisol play balls, drug sundries, toys and automotive parts give better product appeal. The industry has enthusiastically accepted the high production rotational casting machine developed by The Akron Presform Mold Co. It opens up a new field in plastisols.

Whatever your product, our experience can help it's development. Our facilities include designing, engineering and making the machines, the molds and the dispensing units.

THE AKRON PRESFORM MOLD CO.

CUYAHOGA FALLS, OHIO

WAlbridge 8-2105

FORMS	MOLDS	DIES	MACHINERY
LATEX - DIPPING	STEEL AND ALUMINUM	PLASTIC - INJECTION	SPECIAL - AUTOMATIC

Vacuum-Formed

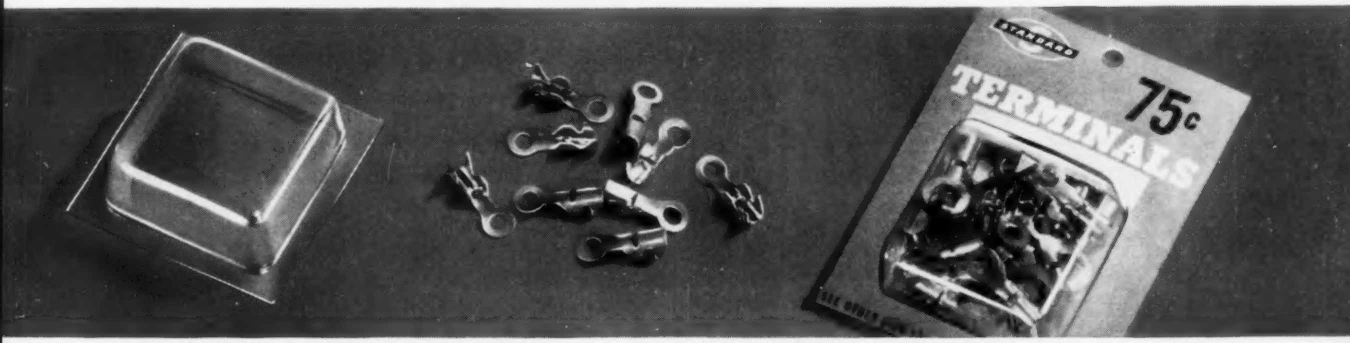
any shape for any product...

Vacuum Formed Packaging with Celanese* Acetate Sheeting gives you a selling package—economically!

Camera lens filter container for Ednalite, by Plastic Artisans, White Plains, N. Y.

Experimental Pack by Skinpak Process of Auto-Vac Company, Fairfield, Conn.

"Pack-a-Domes" display card for Sani-speed Ball Point Pens, by Fabri-Kal Corp., Kalamazoo, Mich.



Dispenser Display Pack for Standard Motor Products, L. I. City, N. Y. By Plaxall, Inc., Long Island City, N. Y.

Wall plaque container for Campbell Soup Company, by Miller Studio Inc., New Philadelphia, Ohio.

"Contour-Pak" for E. R. Squibb & Sons, by Hernard Mfg. Co., Inc., Yonkers, N. Y.

Here is one of the most aggressive packaging methods ever developed. It is so versatile that it can't fail to stimulate ideas. It is so functional that it will give you a new conception of how useful a package can be —in fitting and displaying contents . . . in secondary use possibilities . . . in protection of multiple parts.

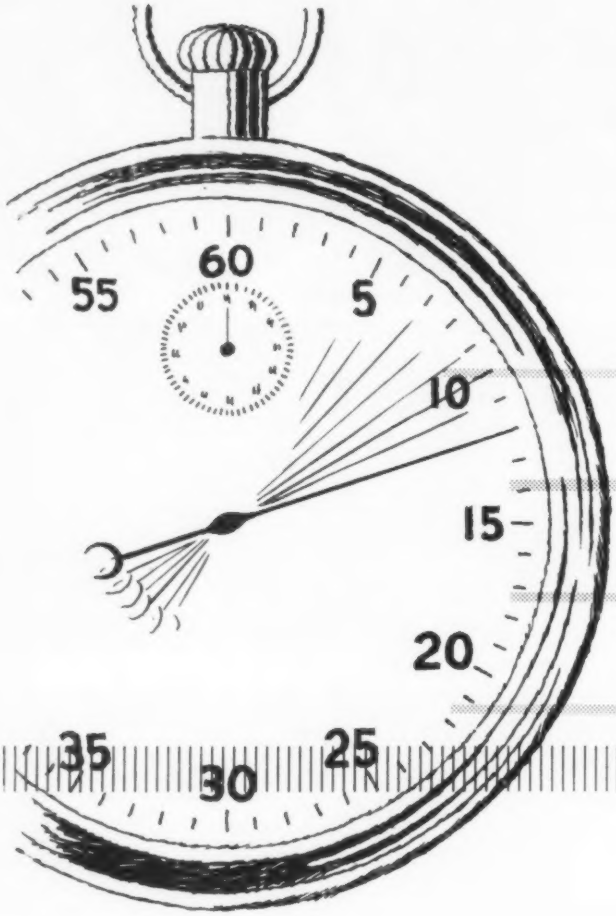
Vacuum forming is adaptable to short or long runs. Molds are simple and economical to produce. The Celanese Product Development staff can tell you what you want to know about probable costs, and put you in touch with fabricators who specialize in this fast growing packaging method.

Celanese Corporation of America, Plastics Division, Dept. 101-A, 290 Ferry Street, Newark 5, N. J. Canadian affiliate, Canadian Chemical Company, Limited, Montreal and Toronto.

Celanese*

PLASTICS

*Reg. U.S. Pat. Off.



WHEN SECONDS COME FIRST!

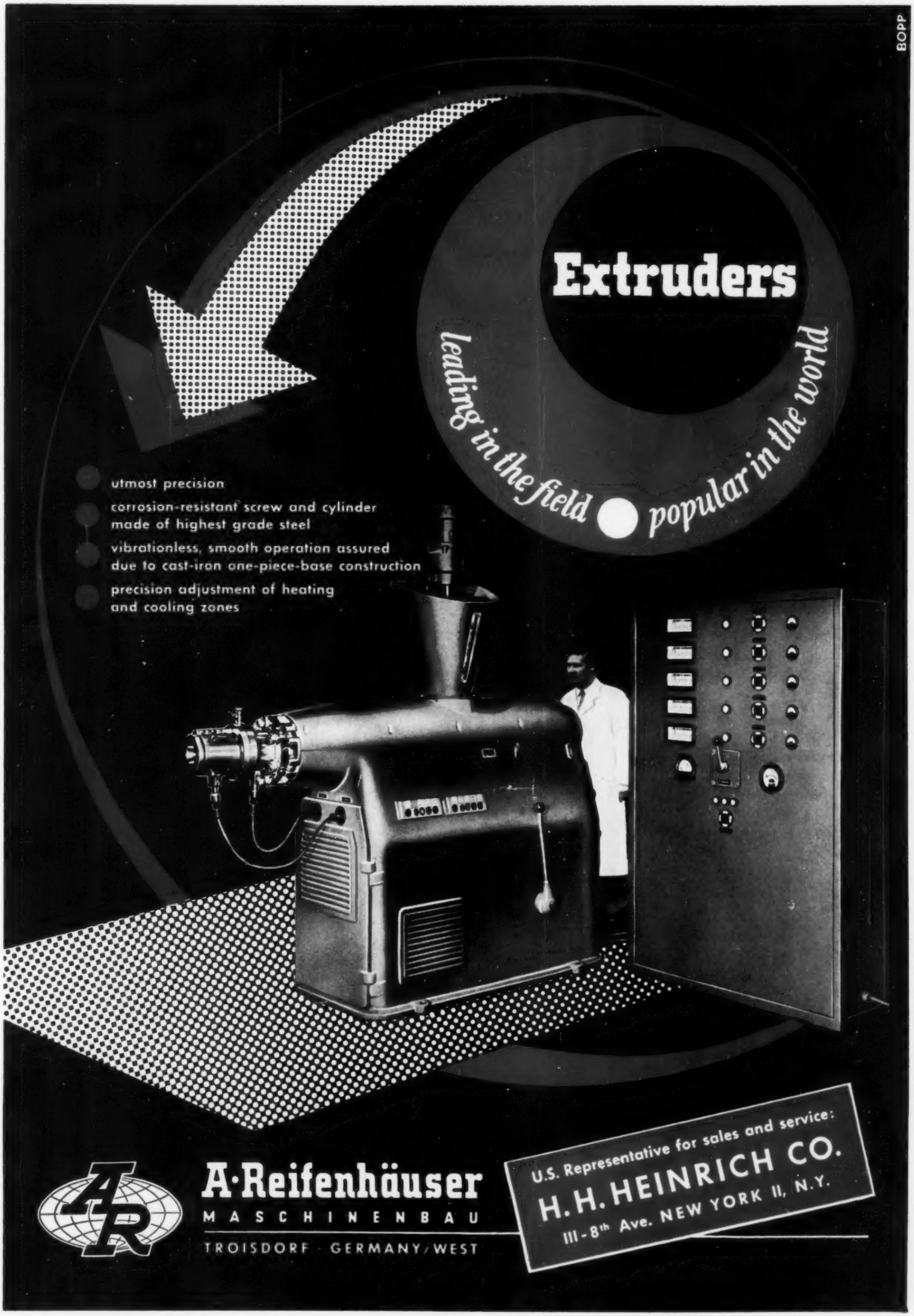
Specialized Bridgeport techniques slash plastic molding, assembling, finishing times to give you better products faster, more economically

First of all, Bridgeport molds to your specifications on the most efficient presses available for your needs. Next, Bridgeport devises special tools and techniques to speed your plastic items through the usual time-consuming steps of assembly, finishing, spraying, drying, and all other secondary operations. Actually, your products flow from press to shipping container *in a matter of seconds.*

Why not investigate how specialized Bridgeport techniques can save you valuable steps, time, and money? Write today to:

BPM BRIDGEPORT MOULDED PRODUCTS, INC.

BOX 3276, BARNUM STATION, BRIDGEPORT 5, CONN.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Extruders
leading in the field
popular in the world
utmost precision
corrosion-resistant screw and cylinder made of highest grade steel
vibrationless, smooth operation assured due to cast-iron one-piece-base construction
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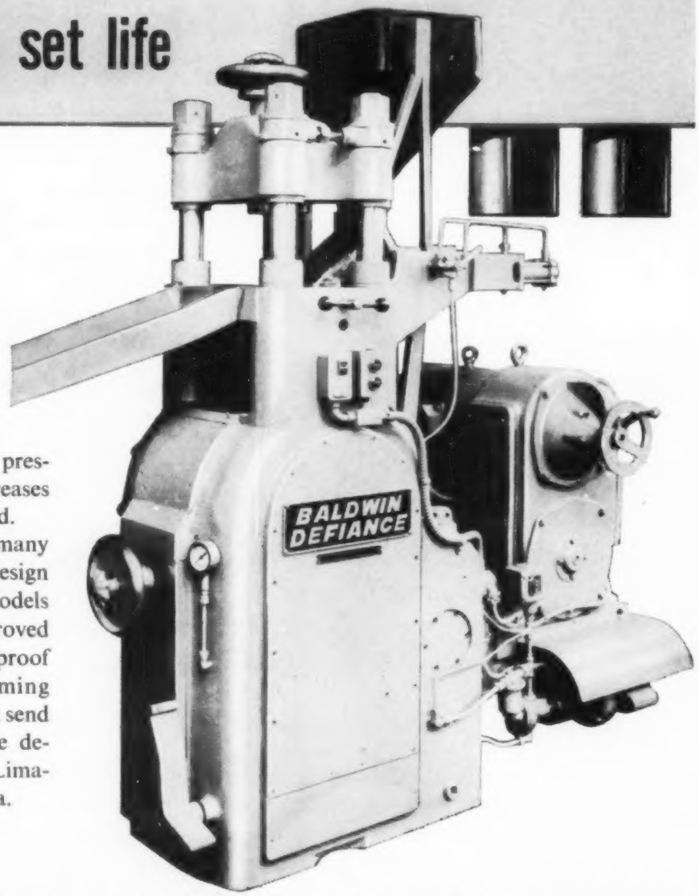
Reduced vibration in BALDWIN plastics presses

increases die set life



Typical of the many outstanding features of Baldwin compacting presses is Baldwin's use of four tie rods to reduce vibration to an absolute minimum. Two connecting rods transmit pressure from the press crankshaft to these tie rods. The resulting balance of pressure practically eliminates vibration. This increases the life of the machine and of the die sets used.

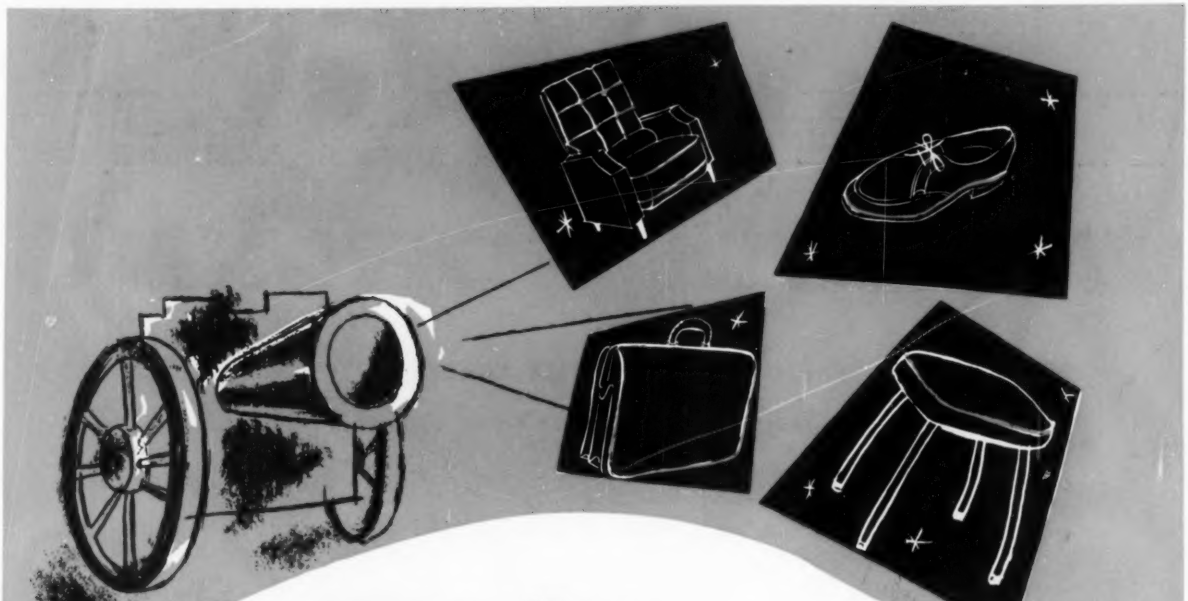
Elimination of vibration is just one of many practical benefits you will get from the careful design and engineering that goes into the Baldwin Models 20 and 45. Each practical advantage has been proved in performance by user after user . . . added proof that Baldwin plastics molding and preforming presses are the finest in the industry. Why not send today for Bulletin #3103 containing complete details? Address Department 4826, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Penna.

EXCLUSIVE FEATURES OF BALDWIN PLASTICS PRESSES

- **Safeguard lubrication** reduces downtime.
- **Balanced pressure** cuts vibration for longer die set life.
- **Simple adjustments** allow weight-density changes during operation.
- **Cam controlled feeder** assures uniform tablet weights.
- **Cleanline design** prevents contamination, speeds cleaning.

BALDWIN-LIMA-HAMILTON

General Offices: Philadelphia 42, Pa. • Offices in Principal Cities



Another Patented **VacForm** Development

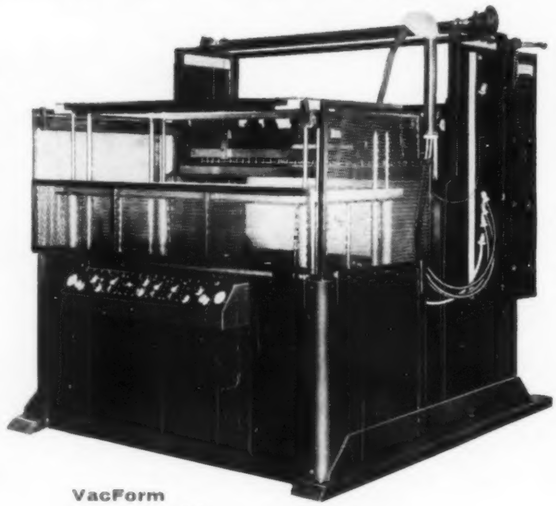
WATER COOLED VACUUM FORMING

New water-cooled mold clamp frame

- Gives faster continuous operation without frame overheating or binding
- Prevents slipping or tearing out of plastic being formed
- Assures perfect registration of mold with preprinted designs; avoids rejects

These exclusive advantages are now possible through the development of a water-cooled mold clamp frame assembly for all VacForm presses. This basic improvement in vacuum forming prevents overheating of the frame. Output is safely speeded up for continuous forming, with no slipping or distortion of the plastic sheet; no production delays from binding of the frame.

Only VacForm presses add water cooling to these profit-making features: push-button operation . . . automatic or manual cycles . . . continuous mass production with quality control . . . vacuum or drape forming from inexpensive male or female molds . . . deep draws with no loss of detail . . . complete mold size adjustability . . . quick progress from design to finished production.



VacForm Model 50-20

One of the presses on which the new water-cooled frame is now standard equipment. This model is adjustable for sheets up to 50" x 24" and draws as deep as 10".

VACFORM

Your most important date . . .
is to see for yourself how VacForm can keep you ahead of competition with faster, more efficient and economical 'round-the-clock mass production of high-quality vacuum formed and drape formed products and parts. With absolutely no obligation —write, wire, or 'phone today for a demonstration.

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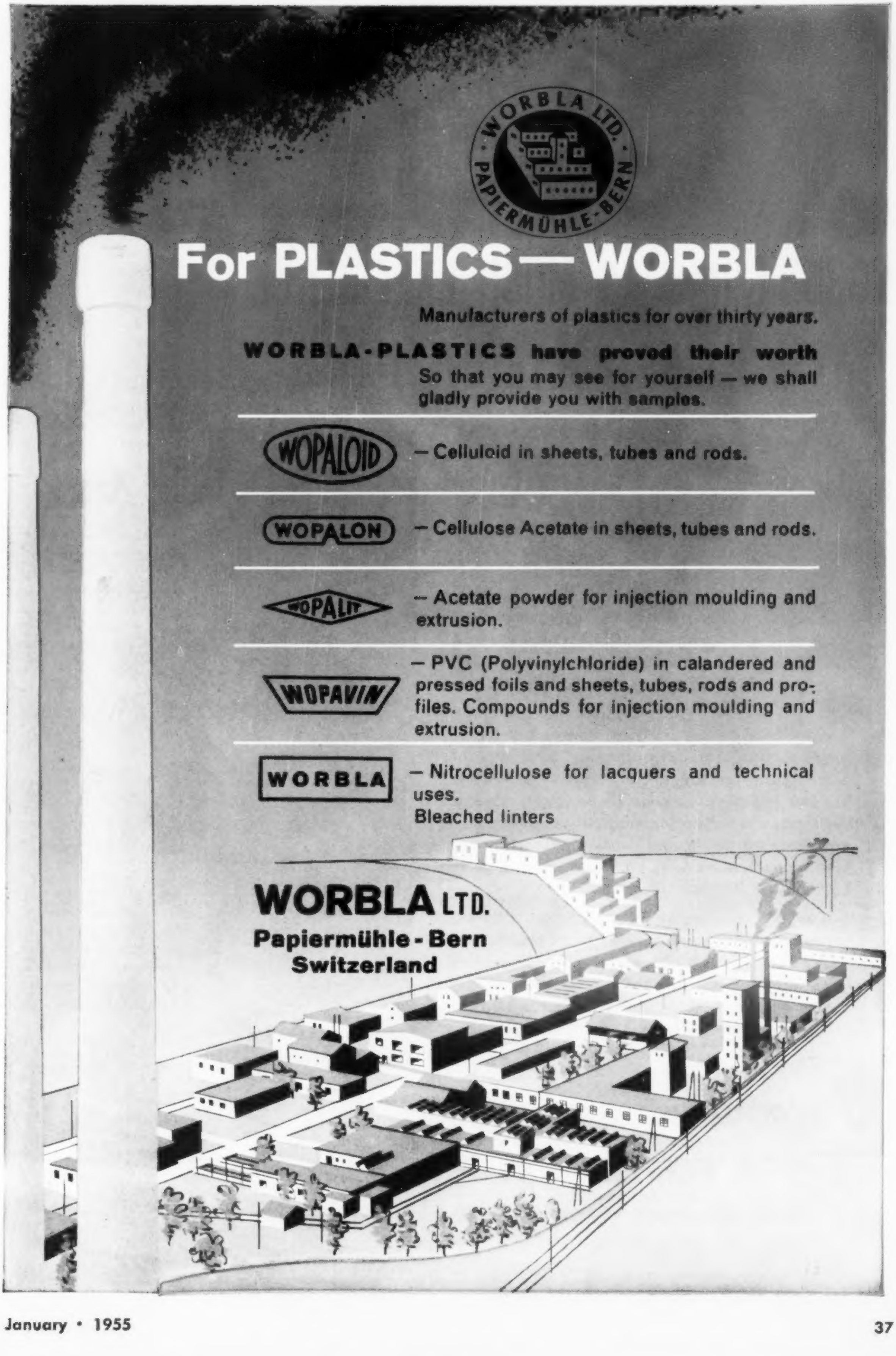
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For PLASTICS — WORBLA
Manufacturers of plastics for over thirty years.
WORBLA-PLASTICS have proved their worth
So that you may see for yourself — we shall gladly provide you with samples.
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– Celluloid in sheets, tubes and rods.
WOPALON
– Cellulose Acetate in sheets, tubes and rods.
WOPALIT
– Acetate powder for injection moulding and extrusion.
WOPAVIN
– PVC (Polyvinylchloride) in calandered and pressed foils and sheets, tubes, rods and profiles. Compounds for injection moulding and extrusion.
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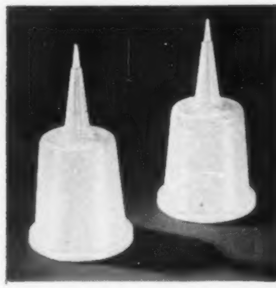
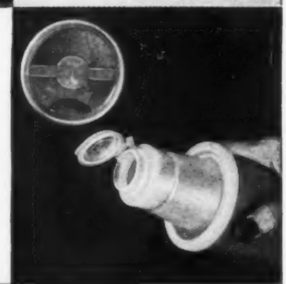
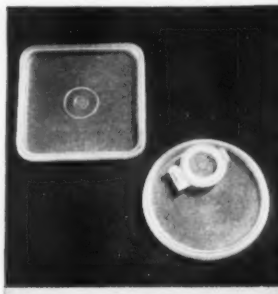


NOBODY HAS AS MUCH EXPERIENCE AT MOLDING POLYETHYLENE AS



TUPPER!



Tupper Seals are air and liquid-tight flexible covers. The famous Pour All and Por Top covers are designed for easy dispensing. They are made in sizes to fit all Tupperware containers.

The logical molder for you to consult regarding that product or package of yours which is to be made of polyethylene is Tupper. Tupper has done more than any other molder to make molded polyethylene a practical reality.

Aside from having designed, patented, and promoted successful seals, closures, and dispensers for polyethylene containers, the Tupper Corporation has vast experience in *every phase* of polyethylene packaging and polyethylene injection molding. This experience will be of major importance in improving your product, in reducing your costs, when Tupper goes to work for you.

Tupper's combination of experience, technical ingenuity, and the most modern equipment is at your service for the custom molding of your product in polyethylene. You can do no better than the best ... and the best at molding polyethylene is Tupper!

When equipped with Tupper Seals, Tupper Canisters, Sauce Dishes, Wonder Bowls, Cereal Bowls and Funnels in various sizes are the most versatile reusable containers you have ever seen.

TUPPER!
TRADE MARK

TUPPER PRODUCTS ARE FULLY PROTECTED

About 150 United States and foreign patents and patents applied for, plus numerous trademarks and copyrights, cover the design and manufacture of the various types of Tupper Seals and other Tupper Products. Unauthorized manufacture of items covered by Tupper patents will subject infringers to prosecution.

TUPPER CORPORATION

***Manufacturers of* — CONSUMER, INDUSTRIAL, PACKAGING AND SCIENTIFIC PRODUCTS**

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MUEHLSTEIN PLASTICS
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Reprocessed • Reground • Unground
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Reprocessed • Reground • Film • Unground parts
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Reprocessed • Reground • Film and Sheeting Cutting Scrap • Misc. General Purpose Low Cost Extenders
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Why gamble when we guarantee the material! You'll find it always pays to do business with Muehlstein. We reprocess Polyethylene, regrind it and custom-color it to your exact specifications and requirements. If you have a special problem take advantage of our complete laboratory facilities and technical staff. Satisfaction assured.
NOTE: We offer top prices for distressed inventories of molded parts, purging and all thermoplastic materials.
WE BUY, SELL AND CUSTOM REPROCESS
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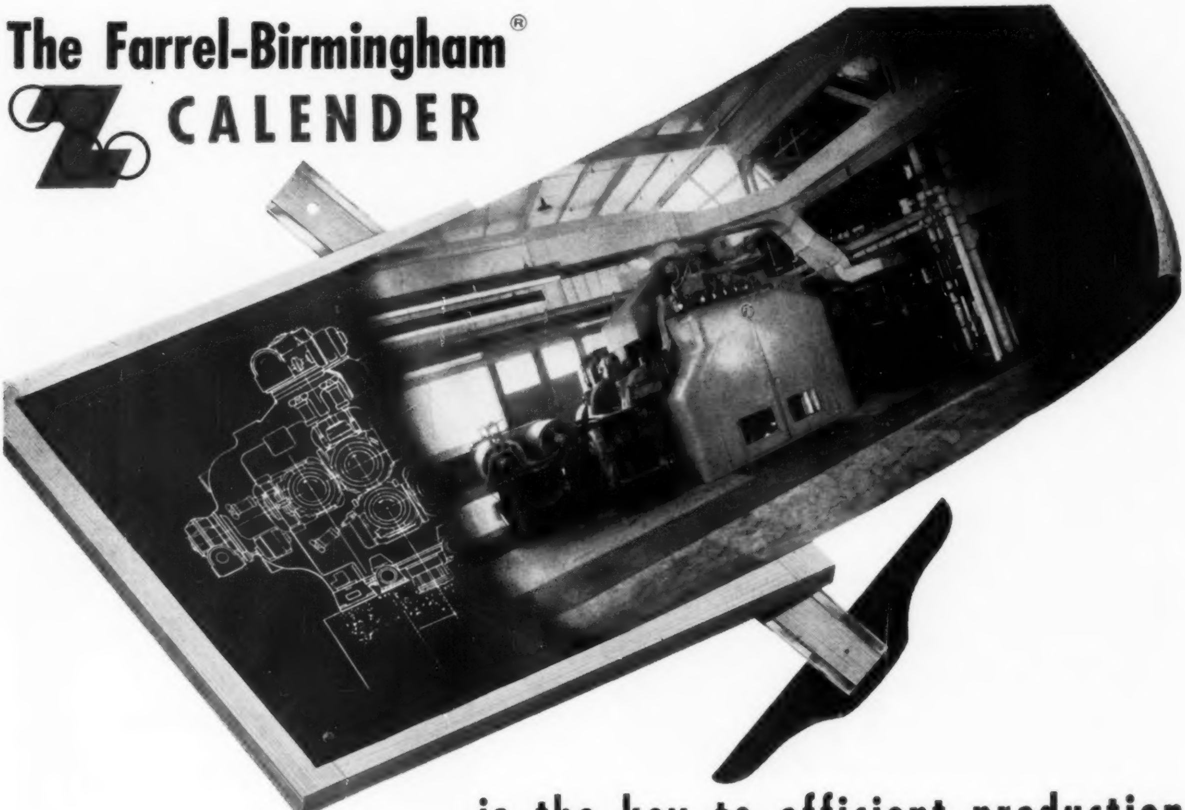
The Farrel-Birmingham® Z CALENDER



is the key to efficient production of plastic film at high speed

The origination and development of the "Z" calender by Farrel-Birmingham established new standards for accuracy, quality and speed in the production of plastic film.

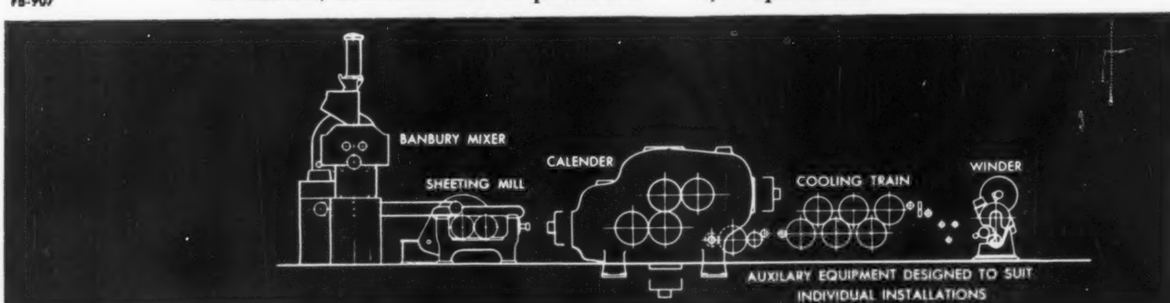
This machine performs the delicate task of calendering plastic film at high speed and high temperature, to a gauge as thin as .002" and less, within tolerances of plus or minus .0001". Employing the crossed-axes device on the final pass, this accuracy can be maintained over a considerable range of film thicknesses.

To further increase the effectiveness of this revolutionary calender, and to give you an efficient, continuous flow of production in mixing, sheeting and calendering plastic stocks, Farrel-Birmingham has developed the Matched Production Unit.

A typical setup is blueprinted below. It consists of a size 3A Banbury mixer, a 22"x60" mill, a 28"x66" four-roll "Z" calender, and the necessary auxiliary equipment. Because each machine is matched in capacity with the other units in the line, production without costly interruption caused by "choking" or "starving" of a unit is assured.

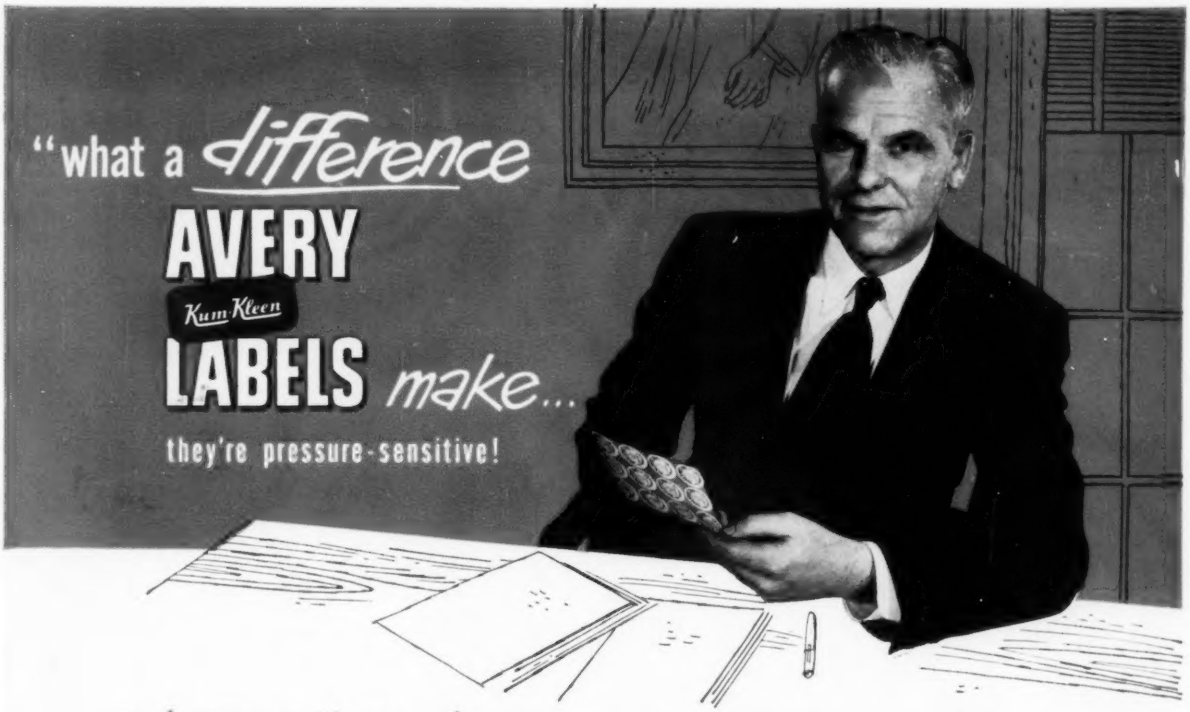
A Farrel-Birmingham engineer will be glad to help you select individual machines or combination units best suited for your specific requirements.

FB-907



Farrel-Birmingham®

FARREL-BIRMINGHAM CO., INC., ANSONIA, CONN.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Los Angeles, Houston



...and save us time and money —in every department!"

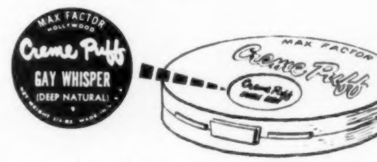
■ On the production line or on the product... in the shipping department, warehouse or office...engineering, inspection or research...in maintenance or management...every place you need to mark or label, Avery can save you time and money—can simplify and speed your work.

■ Avery Pressure-Sensitive Labeling is different because there's no licking or moistening ...no sticky or messy fingers...and no waste motion. They're self-adhesive...on at the touch of a finger—and they're tight, right now!

■ Avery Dispensers—either manual or electric —are available to give you low cost, dependable labeling. They're inexpensive to own and operate...need no special or skilled labor. They'll work into any production line—at any desired speed.

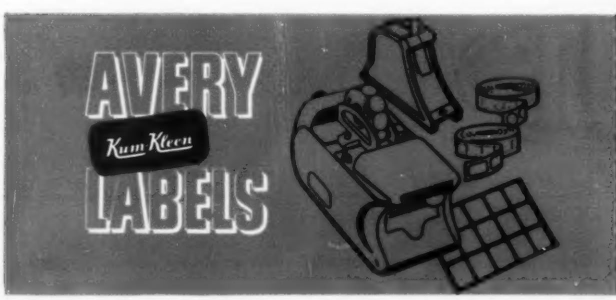
■ Write today for details, free samples and case histories of *Avery Pressure-Sensitive Labeling!*

SPECIFICALLY SPEAKING...



Few firms have as efficient production lines as Max Factor Hollywood! One, for example, easily handles more than 25,000 plastic containers in 6 hours. And only two labeling stations, each equipped with one Avery electric dispenser, handle this job quickly and easily.

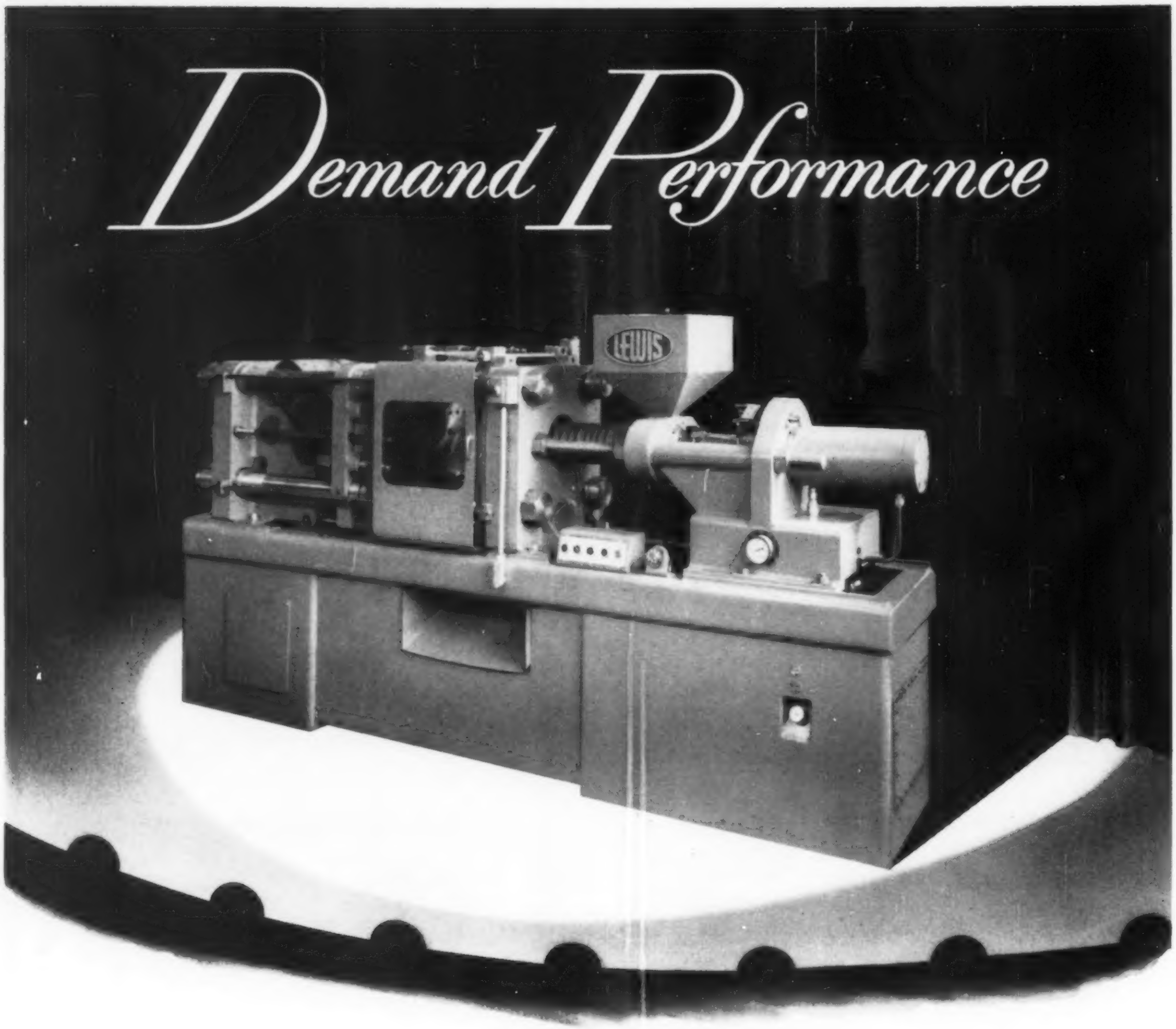
Yes, Max Factor uses Avery Labels by the millions each month...and for a good reason: Avery Kum-Kleen permits extra high-speed labeling of their quality cosmetic products, *plus* an attractive appearance worthy of the legendary name—*Max Factor Hollywood!* Avery Labels can help you, too...whether you use 30 or 30,000 labels a day. Try 'em—they *are* different!



AVERY ADHESIVE LABEL CORP., Custom Div. 128
117 Liberty Street, New York 6 • 608 South Dearborn Street, Chicago 5
1616 S. California Ave., Monrovia, Calif. • Offices in other principal cities

☐ Please send case histories and free samples ☐ Have the Avery Label man call

*Name*______________________
*Company*______________________
*Address*______________________
*Our Business Is*______________________



Featuring the Lewis "6" Injection Molding Machine

The LEWIS Model "6" has been designed to meet injection molders' specific demands for greater economy . . . versatility . . . speed . . . and safety. This new machine can do the work of much larger units at a fraction of their initial and normal operating costs. Engineered to produce a wide variety of large projected area parts, Model "6" will plasticize up to 60 pounds of material per hour . . . mold 7-ounce shots of polystyrene at the rate of 2½ per minute.

An exclusive feature of the LEWIS "6" is the new HYDRA-LOCK clamp . . . the safest, most powerful mold clamping mechanism available today. HYDRA-LOCK utilizes only a cupful of oil to develop a 200-ton clamping pressure in tenths of a second. In addition, its design facilitates quicker, easier mold setting procedures.

For that all-important competitive advantage of high-speed low-cost production . . . specify the LEWIS "6" injection molding machine. It's engineered for demand performance.

Write for Bulletin 102 for complete details.

1570-LW

LEWIS

The Lewis Welding and Engineering Corporation

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plastic extrusion dies and equipment

designed,
built,
tested—
for your
specific needs

Robbins

PLASTIC MACHINERY CORPORATION

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CONSULT ROBBINS' Technical Service for help on your plastic extrusion problems. We specialize in the design and manufacture of shop-tested dies, heavy duty equipment, accessories. Robbins engineers plan and supervise construction of complete extrusion plants. Write today, no obligation.

never say die . . . say Robbins die!

CUSTOM EXTRUSION DIES:

Shop-tested dies, guaranteed for high production, built to your specific requirements . . . from monofilament to sheeting dies up to 60″ wide. Also offset pipe dies for $\frac{1}{2}$″ to 6″ pipe for extrusion of butyrate, polystyrene or elastomeric materials.

CONVEYOR UNITS:

Sheeting conveyors with plain or perforated belt to handle up to 84″ extrusions. Take-off conveyors in 11′ and 20′ lengths with either 6″ or 8″ belt widths have built-in water tanks. Speeds range from 2 to 170 ft. per minute. Double conveyor take-off has Cap-Stan to increase output up to 30% when dual orifice dies are used.

PIPE PULL-OFF and COILING UNITS:

Dual rollers on pull-off units prevent slippage. Bottom rollers run in water for proper cooling of pipe from $\frac{1}{2}$″ to 6″ diameter. Full extruder capacity is possible with separate controls for each set of rollers. Coiling unit designed for neat, efficient coiling of pipe from $\frac{1}{2}$″ to 3″ diameter.

REFRIGERATED WATER TANK:

To maintain accurate control of pipe dimensions, the refrigerated water tank has proved highly efficient. Sizing rings and holders easily attached. Mobility and adjustable height are a few of the desirable features of this unit.

SHEET HAUL-OFF UNITS:

Complete with superfinished rolls and a variable speed transmission. Drive is through heavy-duty worm gear which provides smooth tension on the extruded sheet.

UTILITY SPOOL WINDERS:

Winders designed for any diameter spools, with a speed range from 0 to 200 ft. per minute. Adjustable tension and reversible automatic level wind are highly desirable features of the Robbins winder.

SHEET CUT-OFF AND PIPE SAWS — SHEARS — FORMING RACKS

Full particulars and specifications on request.

CYCOLAC®
THE New HIGH-IMPACT THERMOPLASTIC RESIN
gives your products a NEW DIMENSION for selling . .
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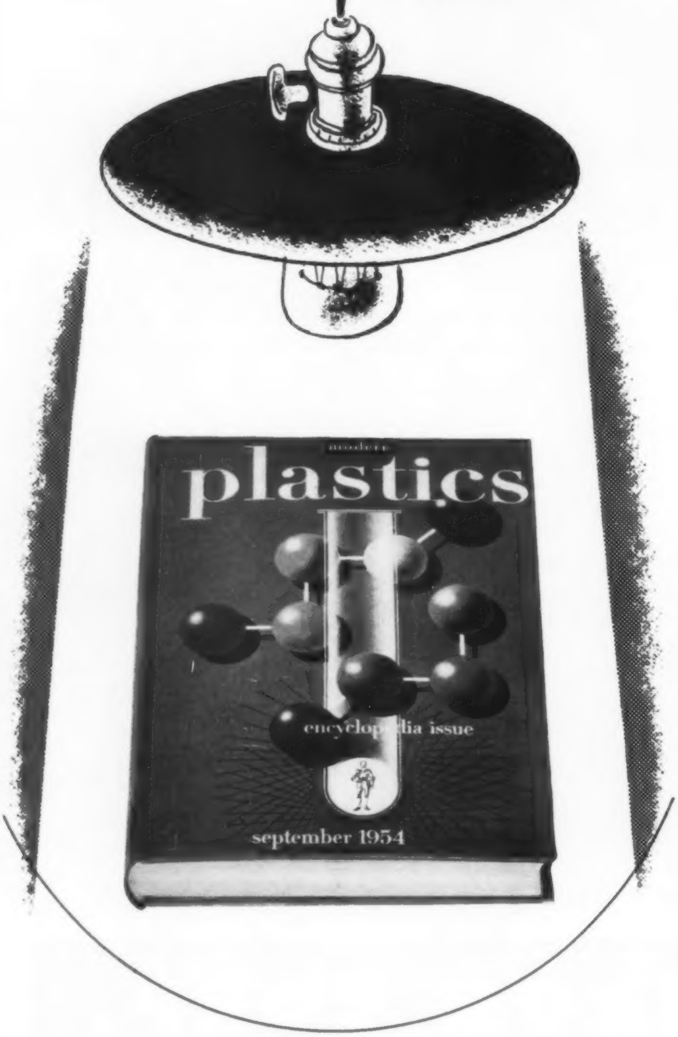
MARBON . . . Precision Resins for Precision Made Products

Off the shelf and hard at work

That's where your copy of the 1954 Modern Plastics Encyclopedia should be



The majority of the material in the Modern Plastics Encyclopedia Issue is *work* data . . . information which most companies utilizing plastics can put to practical use, day-in and day-out.

This 956-page volume gives complete coverage to such important subjects as the characteristics of plastics materials, and the employment of fillers for lowering the cost and increasing the strength of plastics parts. Plastic coatings and foamed plastics are discussed exhaustively, as are all important finishing and decorating methods. Of course, the new cost-reducing slants on vacuum forming, deep drawing, injection molding, extruding and other production techniques are explained, too.

Countless hours of hunting for sources for resins, machinery, equipment and custom services such as molding, fabricating and decorating can be saved by referring to the world-famous Directory Section. It is thoroughly indexed for fast reference. The many ads also help lead you to qualified suppliers.

On the shelf your Modern Plastics Encyclopedia does you no good; at *work* it can be one of your most valuable production tools. Use it often!

MODERN PLASTICS

A Breskin Publication

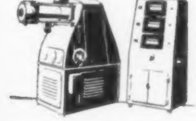
575 Madison Ave., New York 22, N. Y.

Don't Overlook the Helpful Plastics Charts

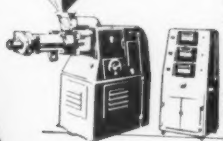
Eight important charts summarize technical data on plastics films, adhesives, coatings, laminates, plasticizers and other vital topics. The plastics properties chart, perhaps the most referred-to section of the Encyclopedia, measures 45" x 28" and is suitable for wall mounting.

QUALITY EXTRUSIONS

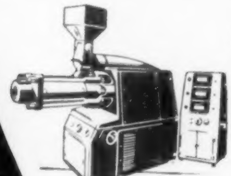
on WINDSOR high production extruders



R.C.65. This is a twin-screw variable speed extrusion and compounding machine with an hourly output of 65 lb. plus. An automatic feeding device for metering plastic material to the extrusion screws is incorporated and automatic heating regulation is provided.



R.C.100. The R.C.100 twin-screw machine is a medium capacity extruder with a nominal output of 100 lb. per hour and will operate continuously over long periods, producing tubes, rods and sections in thermoplastic materials. Coated cables, rods and tubes are standard jobs.



R.C.200. Three screws provide this heavy duty machine with exceptional mixing powers. With a nominal output of 200 lb. per hour, constant extrusion pressures, and trouble free operation, it satisfies the demand for a multi-screw machine of really high output.

The photographs on this page are by courtesy of Messrs. Wallington Weston & Co., Ltd., Frome, Somerset, England. The R.C.100 extruding 6" outside diameter pipe from "Fromoplas HT" material.

Exclusixe Distributors for U.S.A.:
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Canadian Representative:
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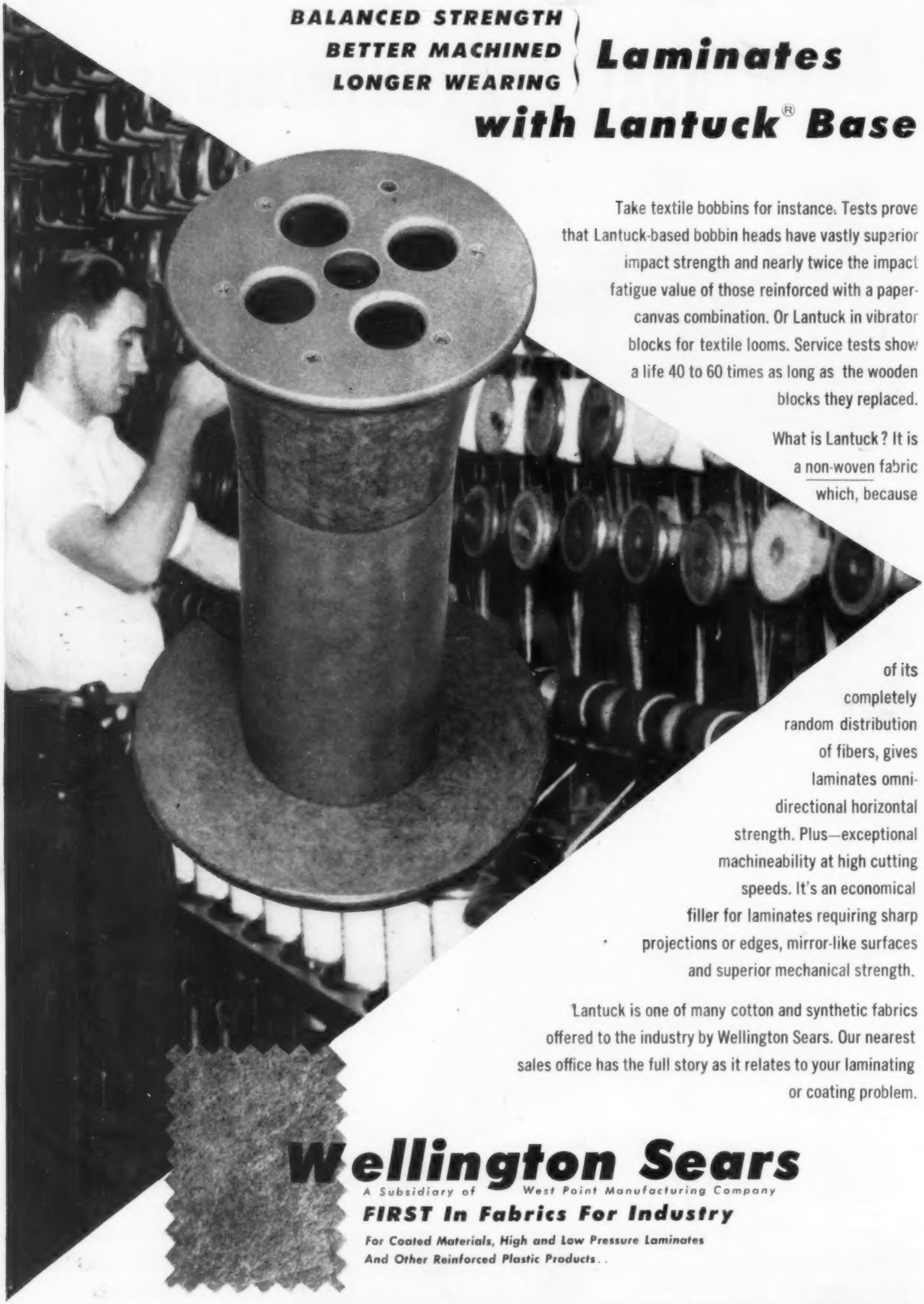
BALANCED STRENGTH
BETTER MACHINED
LONGER WEARING

Laminates with Lantuck® Base



Take textile bobbins for instance. Tests prove that Lantuck-based bobbin heads have vastly superior impact strength and nearly twice the impact fatigue value of those reinforced with a paper-canvas combination. Or Lantuck in vibrator blocks for textile looms. Service tests show a life 40 to 60 times as long as the wooden blocks they replaced.

What is Lantuck? It is a non-woven fabric which, because of its completely random distribution of fibers, gives laminates omni-directional horizontal strength. Plus—exceptional machineability at high cutting speeds. It's an economical filler for laminates requiring sharp projections or edges, mirror-like surfaces and superior mechanical strength.

Lantuck is one of many cotton and synthetic fabrics offered to the industry by Wellington Sears. Our nearest sales office has the full story as it relates to your laminating or coating problem.

Wellington Sears

A Subsidiary of West Point Manufacturing Company

FIRST In Fabrics For Industry

For Coated Materials, High and Low Pressure Laminates
And Other Reinforced Plastic Products..

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This distinctively modern telephone pedestal is custom thermo-plastic injection molded by ERIE for the new N-541 telephone of The North Electric Manufacturing Company.

The streamlined design represents a complex molding job because of the concealed ribs, wells and posts; and the extremely high finish required on the exposed surface. And, to quote the customer, "The high impact case—practically unbreakable—may be removed intact exposing all base mounted parts for easy access."

This is another instance of Erie's proven ability to do the unusual as well as to do the usual with unusual competence.

Write for your copy of bulletin, "Who We Are . . . What We Do in Plastics."

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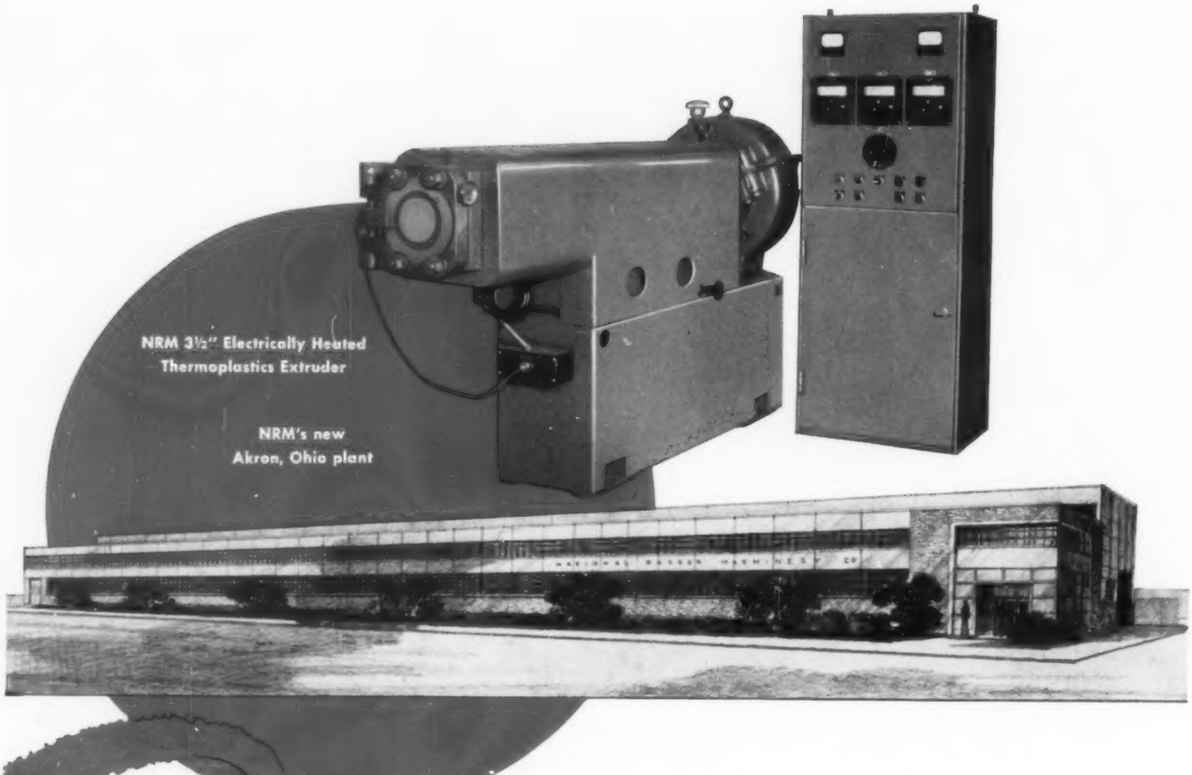

Big things

are happening

OUR CUSTOMERS BENEFIT IN
FASTER SERVICE — NEW DEVELOPMENTS

1954 was a big year for NRM. In sales we not only *continued* our traditional lead, but very likely approached the total extruder sales of all manufacturers combined. In engineering we made significant progress in developing certain new ideas. . . . Others we accomplished fully and their resulting advantages are now *standard* features of NRM Extruders and Accessories.

The heavy demand for NRM plastics machinery made clear, however, the need for greater extruder production on our part. We saw, too, from the many new plastic materials and processes being developed, that new *designs* in machinery would be needed by the plastics industry to assist in working profitably with the new materials, and in making wider use of conventional plastics.

The "big things" happening at NRM are the things we are doing to assure the plastics industry the advanced technical service and processing equipment they need—when they need it!

Increased Extruder Manufacturing Capacity

In Akron we've just completed an eight hundred thousand dollar plant expansion program, doubling production facilities and making our service faster than ever. Completion of government contracts at our Clifton, New Jersey plant has made still more engineering and manufacturing facilities available. Likewise, additional sales and service representation out of both Akron and Clifton, N. J., assures meeting quickly, the NRM Extruder and Accessory requirements of our customers everywhere.

New Developments in Extruders and Equipment

Finding new or better ways to make our equipment more efficient — and thus even more valuable to the plastics industry — is a continuing process at NRM. And as rapidly as we make improvements or perfect new ideas, their advantages are made available as standard features in our lines. NRM's 20:1 extruder ratio, for instance, proved capable of substantial savings on power requirements through higher pounds-per-hour production of top quality extrusions —and all in a machine requiring *less* floor space. This important NRM "first" is now a standard feature of our 2½" Model 50 Extruder. 20:1 ratios in larger NRM Extruders are already operating in custom setups in the industry, and plans to make the 20:1 regularly available in our larger extruders are forging ahead.

Important developments in "packaged" extrusion installations are under way at NRM. Some units already available are meeting wide acceptance in the industry. Typical of these are the plants for rigid sheet extrusion and for PVC pipe. They consist of basic extruder and all dies and accessories *matched* to obtain maximum efficiency in given ranges of work. They are supplied ready to operate as soon as connected to power and water.

About NRM we might say that "big things" not only *are* happening, but that they *keep* happening. . . . The company that gave the industry its first extruder designed specifically for thermoplastics, *continues* its leadership in manufacturing the extruders and accessories which enable plastics producers to do *most* with their materials, at *greatest* profit.

2348

at **NRM**

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VACUUM FORMING

The ABBOTT FAMILY
A MACHINE SIZE FOR YOUR NEEDS
All TWO-STATION Units

MODEL NO.	SIZE	PRICE
APM 30	30"x30"	$2,480.00
APM 40	40"x40"	3,680.00
APM 60	60"x60"	6,100.00
APM 90	60"x90"	9,480.00

(Blowers not included)

- **COMPARE** { DESIGN • ENGINEERING AUTOMATIC FEATURES
- **BENEFIT** { DAY-IN AND DAY-OUT LINE PRODUCTION
- **SAVE** { LOW INITIAL MACHINE COST

Exceptionally Priced
$9480.00
FOB Our Plant, CHICAGO
(Heat Controls Optional)

Now Available!

A PRODUCTION BUILT 60"×90" TWO STATION AUTOMATIC MACHINE

Designed and In Production Specifically For:

1) Refrigerator Inside Liners and Parts
2) Outside Sign Faces. (Brewery, Gasoline, Foods, Etc., where Formed Displays are Required)
3) Air Ducts where Distribution, Curves and Friction Requirements are important.
4) Air Exhaust Baffles to Reduce Noise and Restrict Weather Penetration.
5) Large, Seasonal Window Displays and Merchandising Display Racks, Boxes, etc.
6) Electronic Reflectors and Shields (Metalized after Forming)
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FEATURING

1) Two Working Tables, One Operator, No Lost Cooling Time.
2) 4 Bar Parallel Pneumatic Operated, Mechanically Driven Frame Clamping & Stripping Arrangement 14" Draw.
3) Automatic Program Timers Regulating Primary and Secondary Heat, Vacuum "Off" and Stripping. Adjustments within 1 second for any Operation.
4) Automatic Oven Operation. Operator starts Cycle by Pressing Push Button, Oven then rides over Plastic Material and Returns to a Neutral Position at End of Heating Cycle.
5) Electric Oven Thermo-Balanced to insure Even Distribution of Heat. Inconel Thermo Tubes are Designed to Accomplish a Perfect Thermo Induction between Oven and Material.
6) Dual High Capacity Blowers Cool Material after Forming Operation as well as keep Patterns or Molds in Operating Temperature Range.
7) Automatic Air Pressure Assist Injects Compressed Air Under Plastic Sheet to Help Strip Plastic from Patterns (Std. on a A.P.M. 90 Only). (Extra on Other Models).

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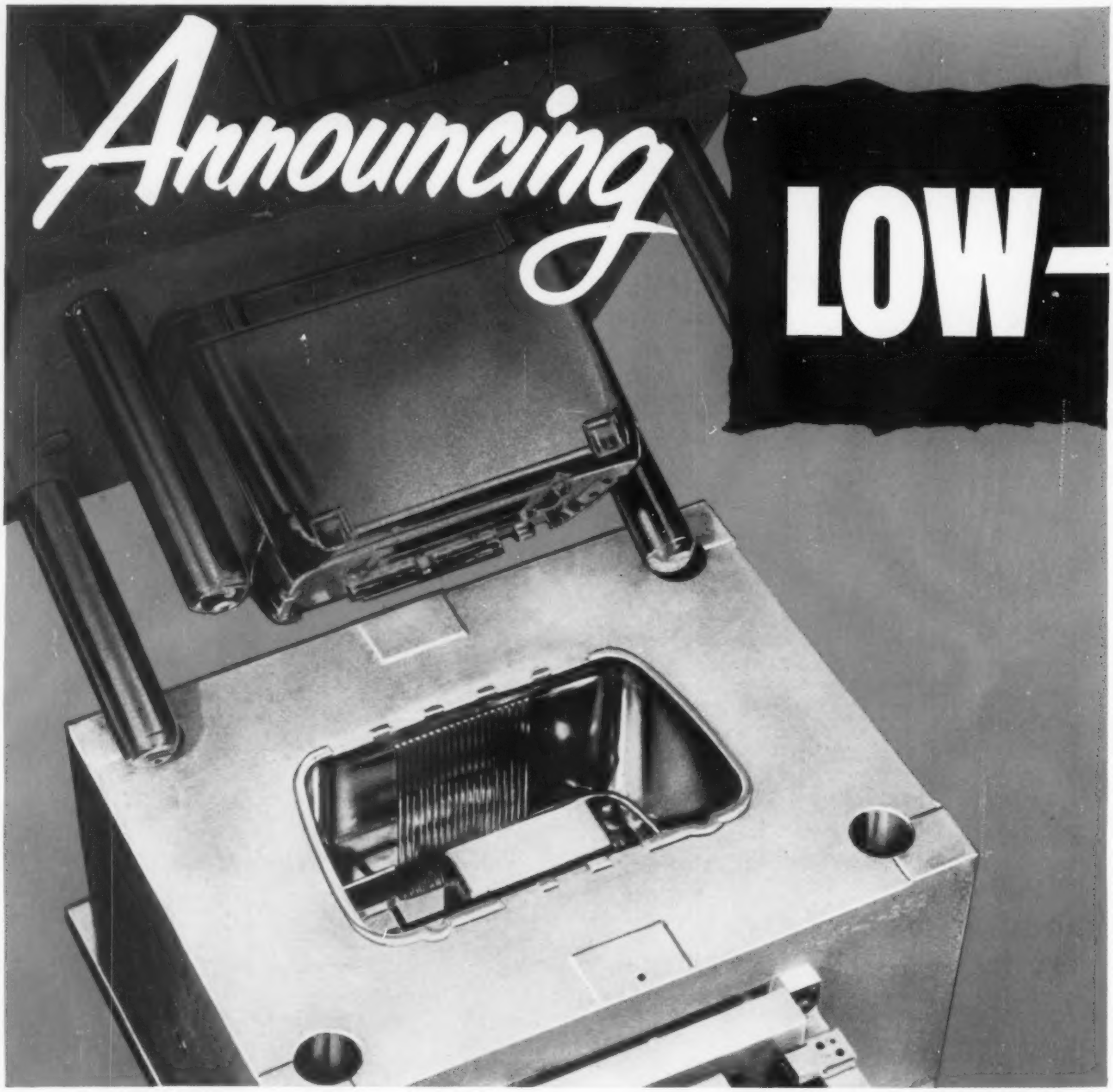
For The Security Of Experience, Insist On ABBOTT



● Large flat areas, points of critical tolerance, gates and runners are particularly susceptible to erosive wear when conventional thermosetting compounds are used. Longer cure times and difficult flash removal are early symptoms of mold erosion—followed by progressive deterioration of molded parts. Such erosion may be reduced as much as 60% with new G-E low-erosion compounds.

General Electric Company
Sect. 1417-5A, Chemical Materials Dept.
Pittsfield, Massachusetts

Please send me the following:

( ) Technical data on new low-erosion compounds
( ) A compound sample
( ) Have your representative call to discuss the application of these new compounds

Name______________________________
Firm______________________________
Street______________________________
City________________ Zone____ State________

COMPARE!

Here is the erosion ratio of the new G-E compound compared with five other leading grades of conventional phenolic material tested by G.E.

COMPOUND	G.E.	A	B	C	D	E
EROSION RATIO*	0.15	1.0	6.3	1.7	2.6	3.3

*Erosion ratio is a numerical value expressing the measured erosive characteristics of the given compound; the lower the value the less erosive is the compound.

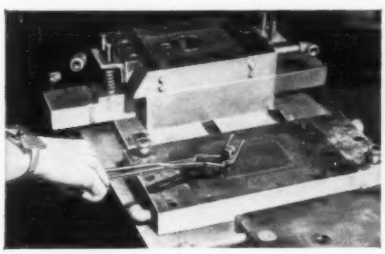
-EROSION MOLDING COMPOUNDS

- **_MINIMIZE MOLD WEAR AND DOWN TIME_**
- **_SAVE ON MOLD REPOLISHING COSTS_**
- **_KEEP FINISHING COSTS LOW_**

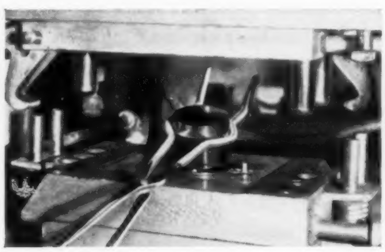
Through the use of radioactive tracer techniques, General Electric has developed a group of *low-erosion* phenolic molding compounds—compounds that minimize the erosive action on expensive molds to a fraction of that experienced with conventional compounds.

Mold erosion can be costly to you—first, perhaps, in increased finishing costs of molded parts as the mold begins to erode, then eventually in the costly process of taking the mold down and having it repolished. Erosion can be a particularly acute problem in large parts with relatively large smooth areas . . . in parts on which extremely close dimensional tolerances must be held . . . and in gates and runners of almost any mold.

Check the table (left) to see the significant difference in erosion rates between these new G-E compounds and several leading conventional compounds. Then mail the coupon (on the opposite page) for complete information and samples to learn for yourself how G-E low-erosion compounds may minimize the mold-erosion problem in *your* plant.



1. In the G-E tracer technique for measuring mold erosion, a radioactive bushing is first placed in the mold.



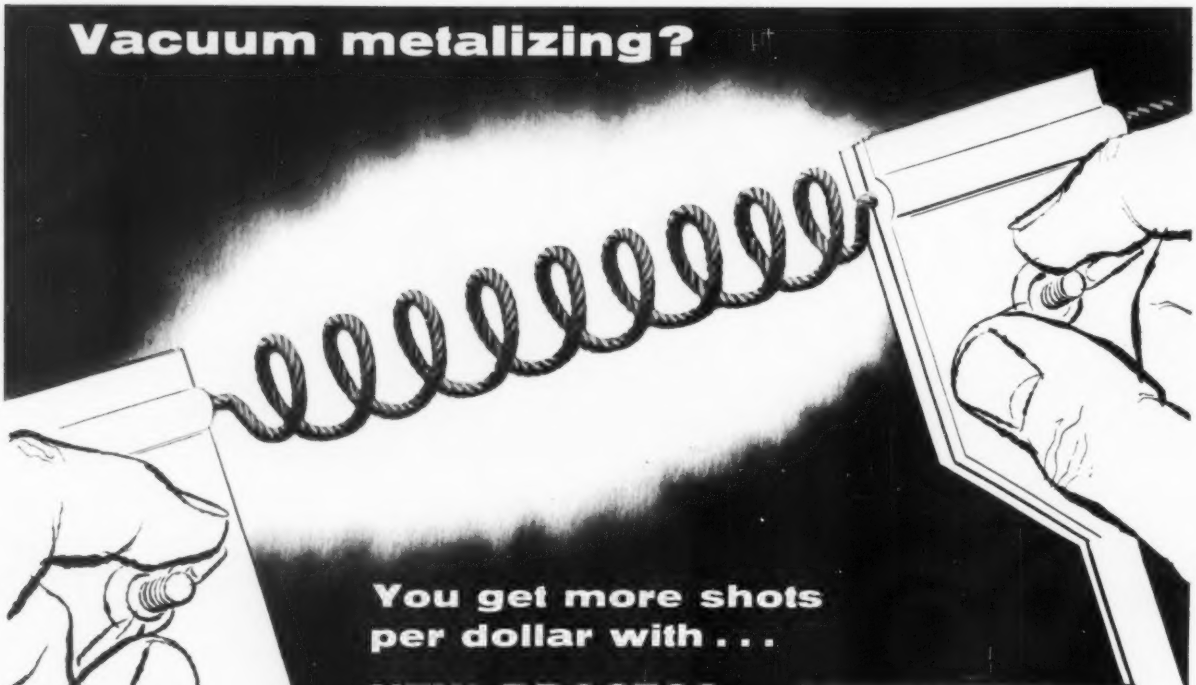
2. Compound is forced through the bushing into the mold to form a test plug. Microscopic bits of radioactive metal eroded from the bushing permit

3. ...accurate measurement of any compound's erosive characteristics, through the use of special measuring equipment.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Vacuum metalizing?



You get more shots per dollar with . . .

NEW PROCESS SYLVANIA TUNGSTEN COILS and STRAND

High-efficiency Sylvania tungsten source heater coils and strand wire were developed especially to give you top performance at minimum cost in any vacuum metalizing application.

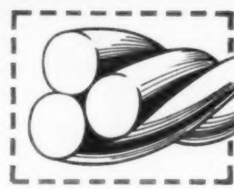
Every step in the manufacture of Sylvania vacuum-metalizing source heater materials is performed under exacting quality control in Sylvania's own plants . . . from tungsten ore, to wire, to finished coils and strand. Special tungsten wire is coiled specifically for vacuum metalizing to assure maximum service life as well as maximum evaporating capacity for your requirements.

Sylvania offers you a wide selection of ready-made tungsten coils, in single or multiple strand . . . each designed for a specific metalizing job. If you prefer to form your own coils, you have a full range of wire diameters and types to choose from.

If you have special application problems, our engineers will gladly help you work them out. Write for your copy of "*Sylvania Tungsten Filaments for Vacuum Metalizing*."

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St., Montreal, P. Q.

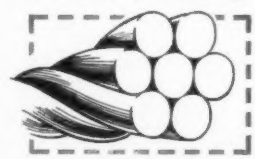
Which is better—



THIS?

Sylvania research has shown that, for the same relative cross section, coils of fewer strands and larger diameter last longer in service.

OR THIS?



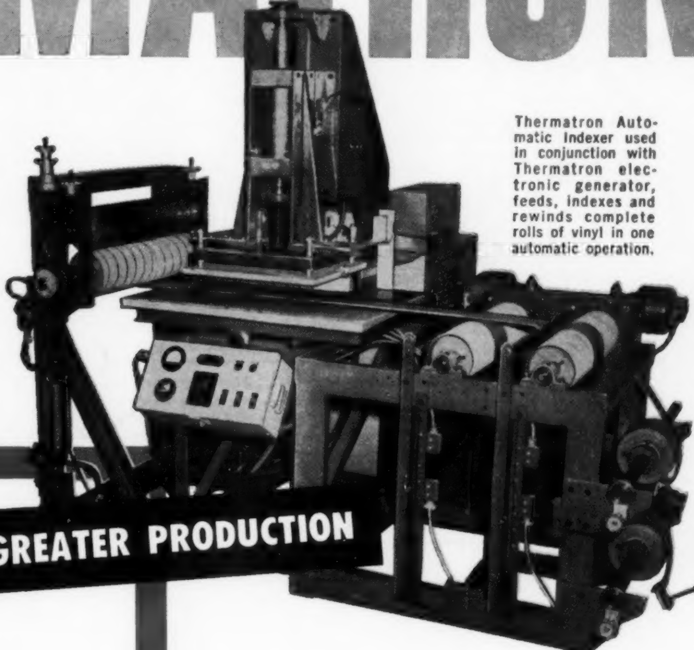
Coils made of a large number of smaller strands are subject to excessive diameter reduction . . . give shorter service life.

SYLVANIA

Lighting • Radio • Electronics • Television • Atomic Energy

THERMATRON

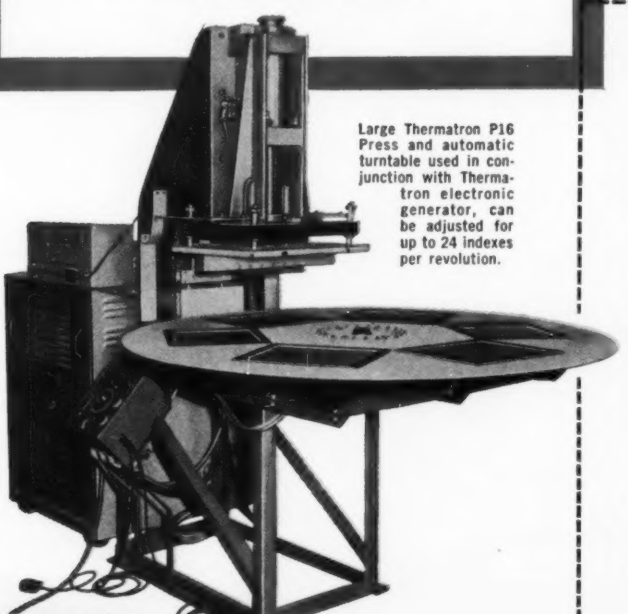
Here's a simple equation for more profitable welding of vinyl plastic...



Thermatron Automatic Indexer used in conjunction with Thermatron electronic generator, feeds, indexes and rewinds complete rolls of vinyl in one automatic operation.

LARGER EQUIPMENT = GREATER PRODUCTION

...at far less cost!



Large Thermatron P16 Press and automatic turntable used in conjunction with Thermatron electronic generator, can be adjusted for up to 24 indexes per revolution.

Today's stepped up competition calls for a review of your production methods with emphasis on speed, economy and "automation." THERMATRON equipment for electronic welding of vinyl answers this challenge with *larger*, automatic machines that slash costs and increase output . . . on both small and large products!

With the same labor, the same cutting and the same handling you now employ, large THERMATRON units such as the P16 Press, Automatic Turntable and Automatic Indexer permit ganging up production runs. The job is done quicker, cost is far lower and the resultant savings are sure to pay for the equipment in no time at all.

Why make do with smaller plastic sealing equipment when larger THERMATRON electronic generators and presses can make yours an *automatic* operation. Write today for complete details on our trade-in offer—and our comprehensive bulletin No. 91.

R&R

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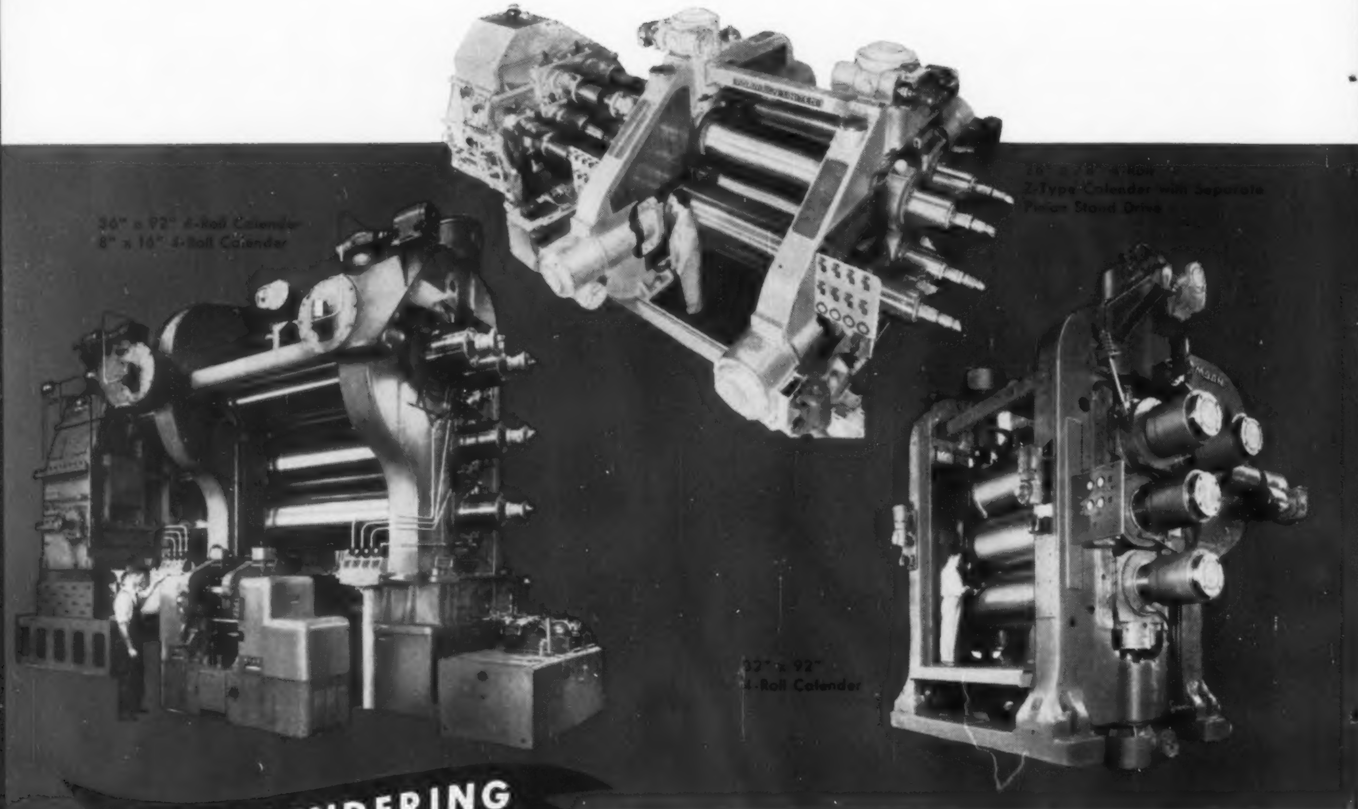

IN CALENDERING

if Crown is a

Because compounding, speed, gage and temperature all have marked effects on roll deflection, crown becomes a major problem in most calender operations. The compromise crown ground on a roll is, at best, satisfactory for only a few operations. When operating conditions are changed, a flat sheet cannot be produced. This usually means that excess material must be used to make sure that minimum requirements are being met. The result is waste and possible quality impairment.

On a crossed axis equipped calender, with separate pinion stand drive, one or more rolls may be crossed to provide the additional crown necessary to compensate for changes in roll deflection. Adjustments are made by a motorized device controlled by push buttons from the operator's control desk.

Roll crossing equipment for crown compensation is not new; it was developed in Europe long ago. We have extended its usefulness by greatly improved mechanical design. In the plastics industry, numerous Adamson calenders have been so equipped for almost ten years. We can furnish crossed axis equipment on any type of calender equipment, varying the design to suit operating requirements.

Why not call us in for a discussion?

ADAMSON UNITED COMPANY

730 CARROLL STREET • AKRON 4, OHIO

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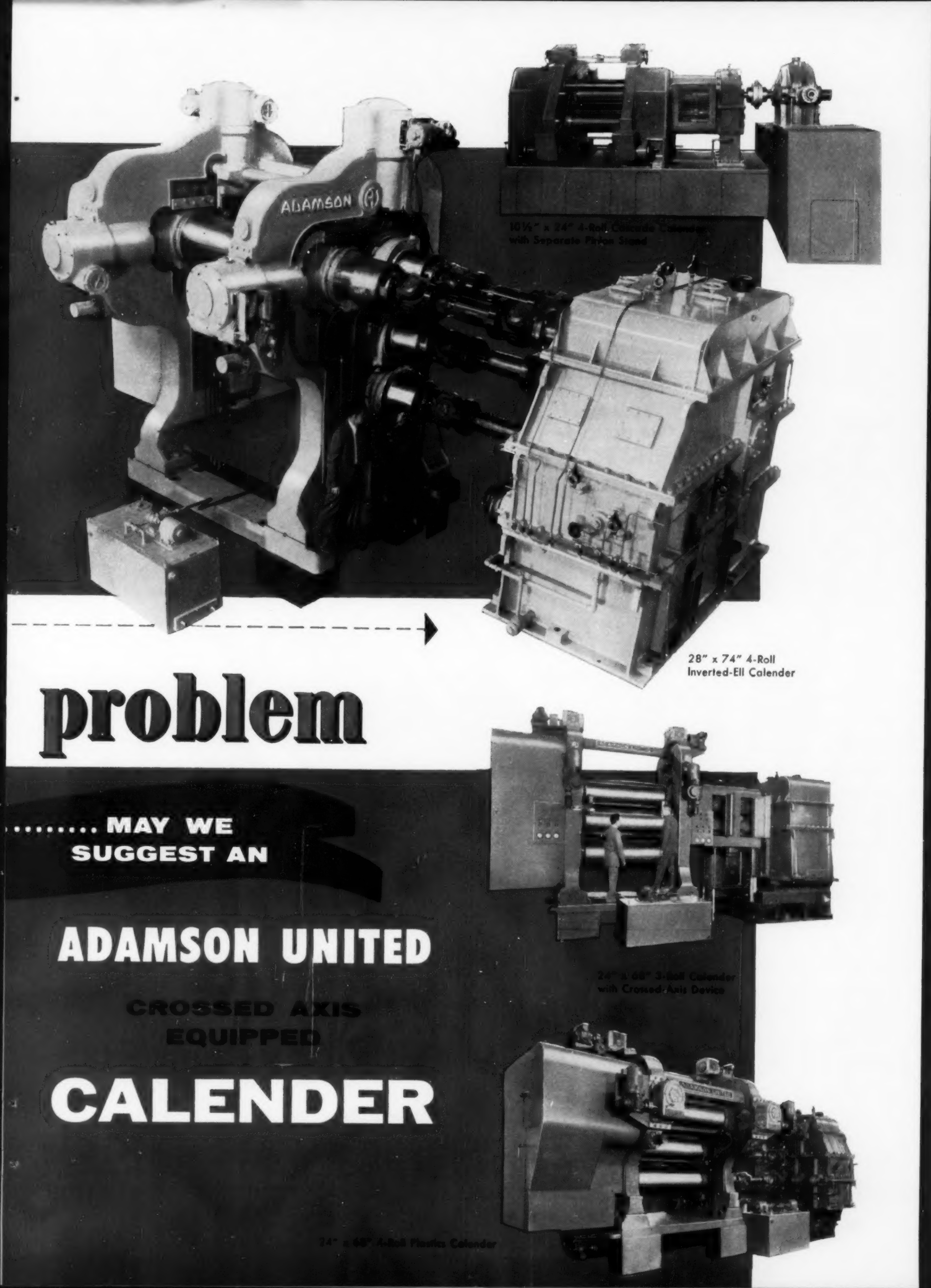
Subsidiary of United Engineering and Foundry Company

Plants at: PITTSBURGH • VANDERGRIFT • NEW CASTLE • YOUNGSTOWN • CANTON


ADAMSON
10½" x 24" 4-Roll Cascade Calender
with Separate Pinion Stand
28" x 74" 4-Roll
Inverted-Ell Calender
problem
.... MAY WE
SUGGEST AN
ADAMSON UNITED
CROSSED AXIS
EQUIPPED
CALENDER
24" x 68" 3-Roll Calender
with Crossed-Axis Device
24" x 68" 4-Roll Plastics Calender

MODERN PLASTICS

JANUARY 1955 VOLUME 32 NUMBER 5

Trends in the Plastics Industry

LIKE the November election, the actual synthetics and cellulosic consumption volume for 1954 won't be known until all the returns are in and the U. S. Tariff Commission has tabulated the results in its annual report which won't be published until next July or August. Even then there will be differences of opinion on the actual sales figure since a large volume of resin, particularly in the coatings field, is consumed by the same company that makes the resin.

Modern Plastics estimates as of this date indicate that consumption volume in 1953 and 1954 was just about the same, with perhaps a few million lb. less in 1954. Increased polyethylene production was the chief factor in bringing 1954 volume close to 1953, since most other plastics either decreased or showed only relatively small gains. Compared to general business, the plastics industry fared well; *The New York Times* Business Index shows all business in 1954 operated at a lower level than in 1953 in every month except November and December.

Then, too, it must be pointed out that 1954 was at least the second best year in all plastics history and when an industry reaches the size attained by plastics it can't escape the up and down trends that affect all business. It is still a safe bet that plastics will continue to grow at a faster rate than general industry for years to come but there are likely to be several leveling off periods like the 1953-54 situation when the general economy declines.

Size of the industry has also affected the traditional pattern of sales performance. Because it is so intertwined with other businesses, plas-

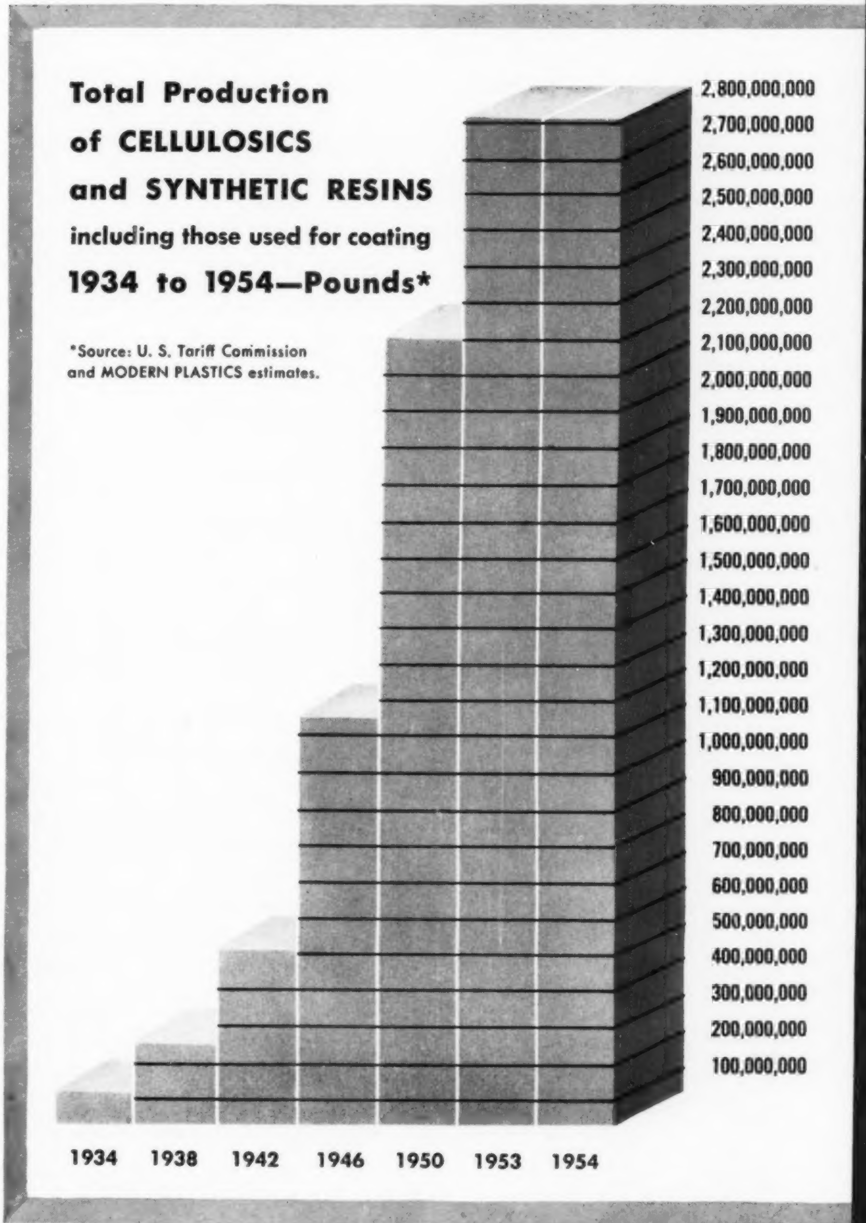


Table I—Sales in Pounds of Synthetic Resins and Cellulosics, Including Surface Coatings, in 1954[a]

Cellulose plastics		
Cellulose acetate and mixed esters		
Sheets under 0.003 gage	16,900,000	
Sheets 0.003 gage and over	12,200,000	
All other sheets, rods, and tubes	5,200,000	
Molding and extrusion materials	73,000,000	
TOTAL		107,300,000
Nitrocellulose sheets, rods, and tubes		4,800,000
Other cellulosics		5,000,000
Phenolic and other tar-acid resins		
Molding materials	168,000,000	
Laminating resins	61,000,000	
Abrasives	8,500,000	
Friction materials, brake linings, etc.	13,800,000	
Thermal insulation binder	33,000,000	
Plywood	24,800,000	
All other bonding resins	13,000,000	
Protective coatings	22,000,000	
Miscellaneous	22,000,000	
TOTAL		366,100,000
Urea and melamine resins		
Textile-treating and textile coating resins	29,000,000	
Paper-treating and paper-coating resins	17,000,000	
Bonding and adhesive resins for plywood	69,000,000	
All other bonding and adhesive uses, including laminating	21,000,000	
Protective-coating resins straight and modified	21,000,000	
Resins for all other uses, including molding	62,000,000	
TOTAL		219,000,000
Vinyl resins		
All types, including chloride, saran, butyral, polyvinyl acetate		495,000,000
Styrene resins		
Molding materials	305,000,000	
Protective-coating resins, straight and modified	82,000,000	
Resins for all other uses	89,000,000	
TOTAL		476,000,000
Alkyd and rosin modified coatings[b]		450,000,000
Coumarone-indene and petroleum polymer resins		200,100,000
Miscellaneous types		300,000,000
GRAND TOTAL		2,523,100,000

[a] Source: U. S. Tariff Commission, first eight months; last four months estimated.
[b] Production figure used rather than sales figure since many paint plants produce their own resin.

tics can no longer be counted upon to have a bigger sales volume in the last half of the year than in the first half. Too much is dependent upon what happens in the automobile, refrigerator, electrical, furniture, construction, and other industries.

An interesting angle in 1954 was the surprisingly good showing made by nearly all plastics in August, which turned out to be one of the best months in the year. Generally it is one of the lower volume months. In the past it has served as a key month in making the MODERN PLASTICS annual survey since it is the last month for which official statistics are available before the survey is completed. Experience had taught that the four remaining months could generally be estimated by using August as a base and figuring a certain percentage of increase for each of the next four months. In 1954 the old percentages went awry and a new scale had to be set up.

The August high was variously attributed to a threatened truck strike (which didn't materialize) and to low processor inventories suddenly replenished in preparation for good fall business (which didn't pick up as much as was anticipated).

Vinyl resins led in poundage produced in 1954. This classification includes saran, polyvinyl acetate, polyvinyl butyral, miscellaneous resins that include less than 50% vinyl chloride, and a small volume of others. The fore-named materials accounted for a little over 100 million pounds. The balance of the 495 million lb. figure in Table I was polyvinyl chloride and vinyl-chloride copolymers.

Second on the list were styrene type resins with a total of 476 million lb., of which approximately 300 million lb. was for molding material.

Alkyd resins and rosin modified materials used in paints and enamels were next on the list.

Phenolics tumbled from a total of about 430 million in 1953 to 366 million in 1954. They were hit by the decline in television cabinets, appliances, plywood, and similar end products where production was cut.

The growth in miscellaneous materials was occasioned largely by polyethylene although almost every item in this classification grew to some extent. They are chiefly acrylics, nylon, epoxies, alkyd molding materials, and fluorocarbons.

Materials Supply and Demand

PHENOLICS

AS INDICATED by the graph on page 73, phenolic molding powder is the most temperamental performer in the plastics industry when it comes to production volume. That may be a strange commentary on a material that was once thought of as the backbone of the plastics industry but, as one observer in the industry puts it, the old work horse has become a temperamental race horse that runs only when she feels like it.

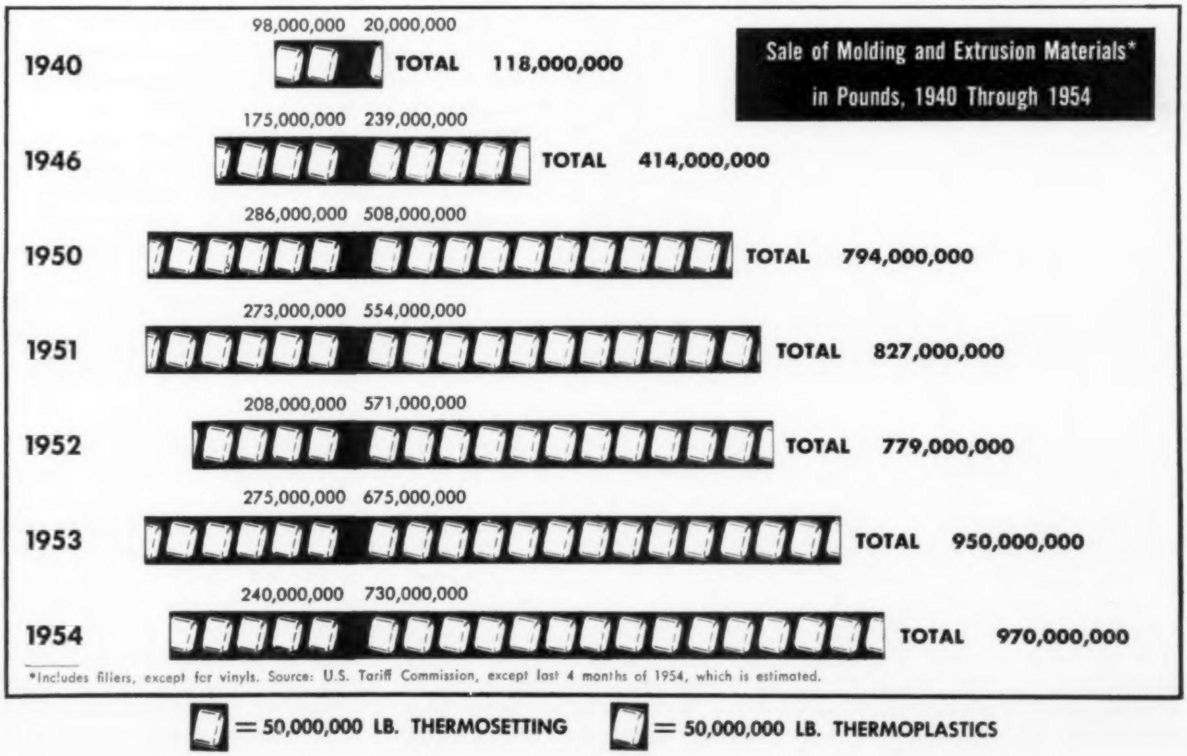
Perhaps the explanation is fairly simple. Except for nitrocellulose, phenolic is the oldest of the plastics and has reached maturity. That doesn't mean that growth is stymied; new uses may come along any day, as did television cabinets in 1952 and 1953. But, generally speaking, use of phenolic molding powder since 1945 has been governed by the course of all industry. The only difference has been that phenolic goes up or down more precipitously than does general business. Phenolic has ranged from the lowest monthly production since the war of less than 5 million lb. in July 1949 to a peak of 22 million lb. in August 1950. The big drop in 1949 was caused by the steel strike when nearly all business was partially paralyzed and there was little benzene available for resin production. (See graph, p. 73.)

The phenolic industry really came into its own during World War II when capacity increased from 70 million lb. a year in 1940 to about 150 million lb. in 1944. Since that time, capacity has been built up to probably over 300 million lb. a year, but sales have never gone much over 200 million pounds. (See Table II, p. 72.) The significant factor is that the industry was able to absorb the increased capacity of wartime with scarcely a ripple and without significantly changing it's pattern.

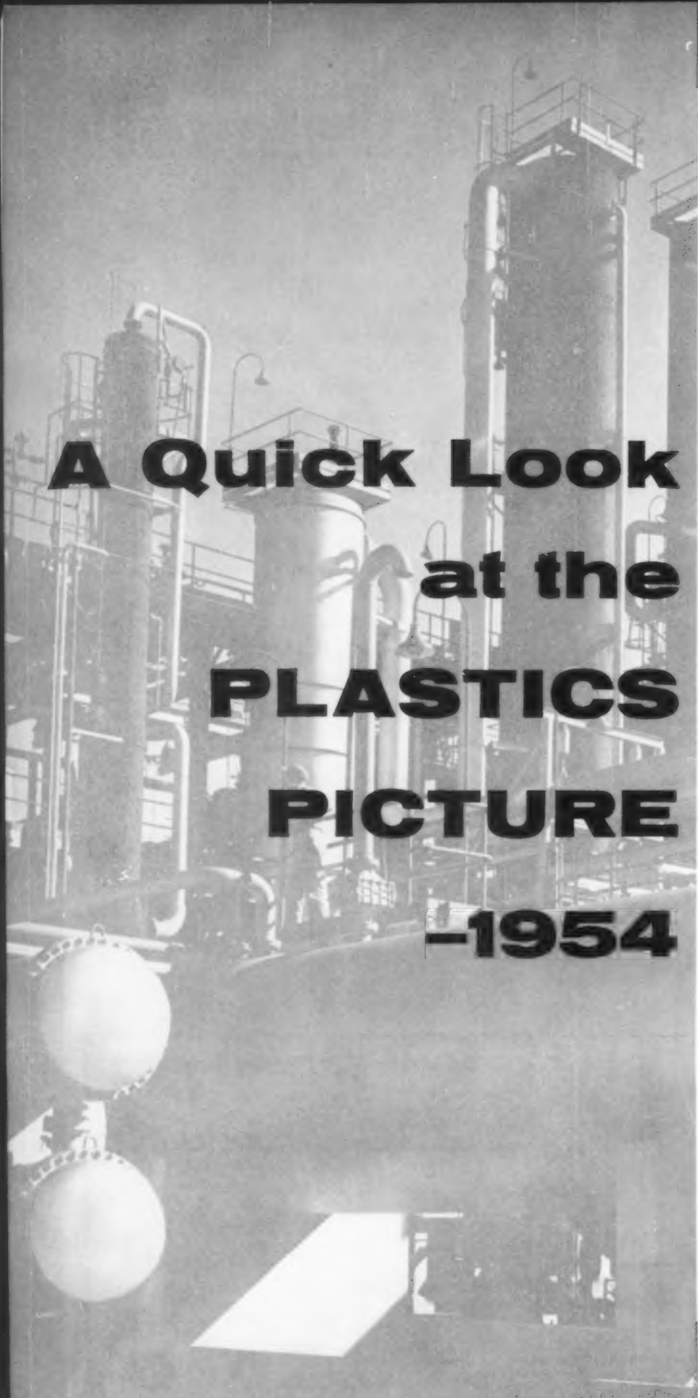
A corollary to this is that during the Korean war the molders accepted military business and never so much as missed a beat on civilian business.

Broadened Bases — How long can an industry continue to grow without spreading its base of operations? That's a question to which the phenolic molding industry must soon find an answer.

Up to now, phenolic molding growth has resulted from the general rush to buy anything available after World War II and the increasing size of individual molded parts such as iron handles, pot handles, and electrical control parts. Even the television cabinet is just an over-size radio cabinet, and that application was well established before 1940. Furthermore, the industry is threatened with more competition or obsolescence in such fields as closures, vacuum tube bases, washing machine agitators, telephones, television cabinets, wiring devices, cameras, and probably others. The one big favorable outlook is that the growing electrical industry will probably



*Includes fillers, except for vinyls. Source: U.S. Tariff Commission, except last 4 months of 1954, which is estimated.



A Quick Look at the PLASTICS PICTURE —1954

PHENOLICS

All phenolics declined from 430 million lb. in 1953 to 366 million in 1954. Molding powder declined from 204 to 168 million pounds. Great part of loss was in television cabinets. Failure to gain in specialty resins such as shell molding, wood waste, and other bonding applications was a disappointment. However, this industry is accustomed to ups and downs. Next year it will probably be high.

ACRYLICS

Molded acrylics dropped somewhat in automotive parts due to auto industry decline, but amount used per car is increasing. Lighting panels are increasing. Both cast and extruded sheet are gaining ground for signs, lighting, and glazing. Lower cost cast sheet was introduced.

CELLULOSICS

Acetate and butyrate volume in 1954 was almost equal to 1953. Acetate molding material seems to have permanently regained large part of market lost in early '50's. Film and sheeting increasing their range of packaging uses. Butyrate producer announced a new sheet suitable for outdoor use.

increase its demand for phenolic control parts by many-fold in the years to come.

Looking for Markets—A committee of molders has struggled with the problem of finding new markets for large molded pieces, but so far results have been less than startling. It is difficult to understand, for example, why such practical, sensible articles as molded phenolic furniture drawers haven't caught hold; they are in production but volume remains tiny.

There is no simple answer to the phenolic problem. It seems likely that there will be good markets for years to come in most of the present applications, but a permanently assured growth hinges upon development of new outlets. Research, engineering skill, and the ability to ferret out possibilities are now more important properties to the phenolic industry than heat resistance, electrical properties, or any other properties.

Better Resins — Meanwhile, resin producers continue their search for better and more utilitarian resins. But there are already thousands of formulations on the market and the consequent production and distribution problems cause many a headache. Scores of applications molded in plants from Maine to California

UREA AND MELAMINE

Slight decline in urea, but melamine dishware continued steady climb. New melamine-glass resin expected to improve sales in electrical industry. Urea producers now concentrating on selling urea as a specialty material for a quality market.

NYLON

Continued increase in number of uses for nylon. Producer has at least 1000 items undergoing evaluation. Automobiles now use about ¼ lb. per car—will use more later. Chief use is still in bearings, bushings, and gears. A new formulation for outdoor use was announced. A new producer will start production in 1955.

POLYSTYRENE

Molding material sold was approximately 300 million lb. in both 1953 and 1954. High-impact portion in 1954 is estimated at about 120 million pounds. Copolymer production is estimated at between 15 and 20 million pounds. Housewares and toys declined, but part of that market is expected to be regained with high-impact. Packaging uses increased handsomely. An over-all increase of 10% is expected in 1955.

POLYETHYLENE

Sales figures grew from 145 million lb. in 1953 to perhaps 195 million lb. in 1954. At end of 1954, industry could have supplied 26 million lb. a month if there had been that much demand. Film sales in 1954 were estimated at 70 million lb. in contrast to 44 million lb. in 1953. Material for injection molding grew from 21 million lb. in 1953 to 32 million lb. in 1954. Use as a coating material on paper and cellophane grew rapidly after a slow start made several years ago. By the end of 1955, there will be facilities to produce 550 million lb. annually, but it will take a long time to install equipment and establish markets sufficient to use the amount of polyethylene available. Nevertheless, industry feels that potential markets will absorb 600 million lb. in three or four more years.

VINYL CHLORIDE

Industry consumed about 375 million lb. of domestic resin in 1954 compared to 360 in 1953. Largest growth was in floor covering. Important growths were registered in wire covering and fabric coating. Film market hurt by a "profitless" operation. Unsupported sheet finds new markets to replace those lost to coated fabric. Outerwear and wall covering applications made "hits" during the year. Industry has capacity for almost 600 million lb., yet many potential producers seem to covet a spot in this already over-capacity industry.

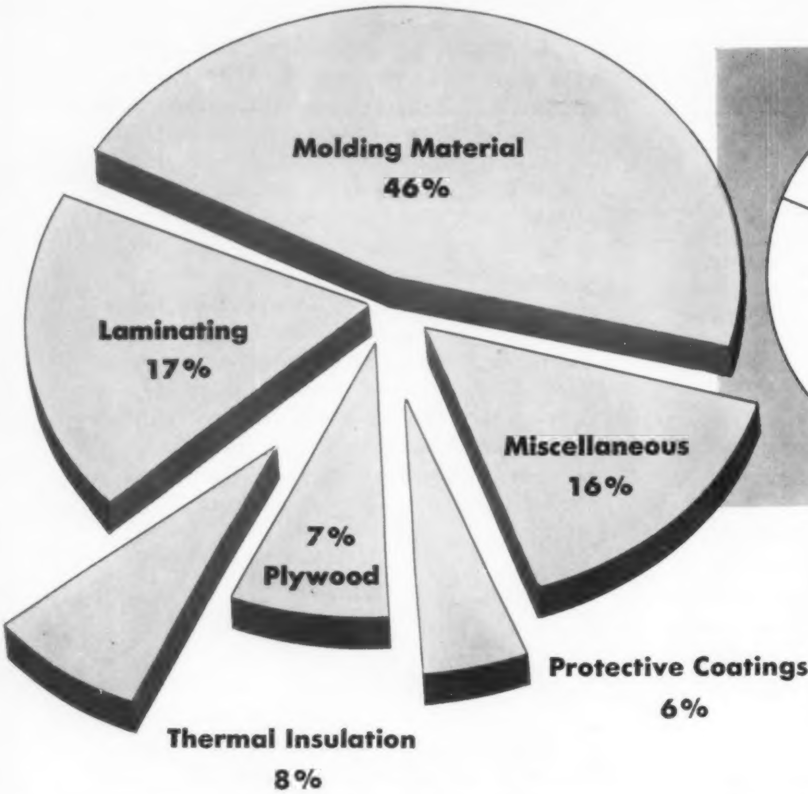
are each designed from a special formulation that has no other use than that one particular job, and the molder raises a terrific rumpus if the producer stops production. Few if any molders want to change formulations on a job when it is running satisfactorily.

However, the producers are moving toward more utilitarian general-purpose resins as much as possible. During the past year, nearly all of them have announced new and improved resins of that type. The new materials have faster flow rates and set up faster than was the case with the older resins.

Improved Fillers — Experimentation with new fillers goes on continuously. A producer of rubber modified phenolic has just announced enlargement of facilities to produce the material, which must mean that progress has been made. The idea of a phenolic-rubber resin has always sounded wonderful because of the possibility of improved impact strength; but, until recently, the extra cost seems to have outweighed the advantages, except in a very few applications. Glass-filled phenolic is reported to have been quite satisfactory in imparting impact strength for such uses as welding gun handles, but it is primarily a high-cost, specialty resin and is not expected

Phenolic Consumption by End Uses

1954



1953

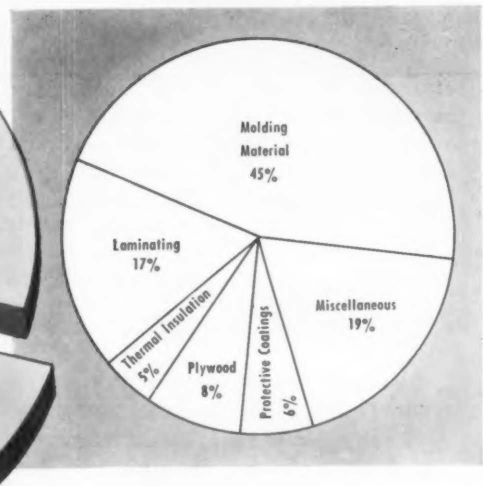


Table II — Phenolic Resin Sales[a, b]

Type	1954 lb.	1953 lb.	1952 lb.	1951 lb.
Molding materials	168,000,000	204,000,000	158,000,000	205,000,000
Laminating resins[c]	61,000,000	71,000,000	69,000,000	74,000,000
Abrasives	8,500,000	12,000,000	———	———
Friction materials, brake linings, etc.	13,800,000	16,000,000	———	———
Thermal insulation— rock wool, fibrous glass	33,000,000	21,000,000	———	———
Plywood[d]	24,800,000	34,000,000	40,000,000	38,000,000
All other bonding resins	13,000,000	18,000,000	———	———
Protective coatings	22,000,000	26,000,000	24,000,000	23,000,000
Miscellaneous[e]	22,000,000	28,000,000	61,000,000	72,000,000
TOTAL	366,100,000	430,000,000	352,000,000	412,000,000

[a] Source: U. S. Tariff Commission, except last 4 months in 1954, which is estimated.
[b] All on a solid resin basis, except molding powder, which includes over 50% filler.
[c] Production figure used instead of sales figure because there are so many captive plants.
[d] Plywood figures uncertain because it is not known whether or not all companies report.
[e] Miscellaneous figure was not separated into various categories until 1953.

to reach a volume of more than a few million pounds a year. Mineral-filled phenolics, although highly useful in certain jobs, probably account for no more than 10 or 12% of the total phenolic production.

Television Cabinet Troubles—Total phenolic molding powder sales declined more in 1954 than any other major plastic. Some molders were running at a normal, profitable rate; others had almost no business at all. Most of the drop is credited to the decline in television cabinets, but there was also a small decline in almost every classification. The sad situation in television cabinets derived from the competition of lower cost materials such as metal and painted fibreboard. Even the original developer of a large phenolic cabinet has now added metal and fibreboard cabinets to his line. One producer claims that one die for a steel cabinet will give him four times the production speed of phenolic molding.

This same factor of faster time cycles in metal stamping than in thermoset molding, has also held back possible large-scale sales possibilities in thermosetting air conditioner housings. Thermoplastic parts used in the front of an air conditioner housing don't have this handicap. They can compete with metal price-wise because of the faster production rate obtainable by injection molding. And vacuum forming bids fair to change even this picture.

It is possible that color television may help restore thermoset materials for cabinet construction. Robert W. Sarnoff says that there will be 10 million color receivers in use in 1959. The need for a great number of tubes in a small cabinet might result in electrical interference in a metallic cabinet; phenolic would

then be almost obligatory. But that situation is still several years away. At present, the phenolic industry is attempting to remedy the television cabinet trouble by using a lower grade molding powder and painting the surface, but paint will scratch and therefore is undesirable.

Electrical control parts — circuit breakers, condensers, resistors, switch gear, panel boards, etc. — should be a growing market for years to come. The business is split about half and half between proprietary and custom molders. Total volume given in Table III is subject to change since different companies report various products in this classification; however, this is the biggest outlet for molded phenolic.

New Electrical Uses — One company estimates that volume for electrical control parts should increase by at least one-third in five years. Quoting Mr. Sarnoff again, 50% of the electronics industry in 1961 will be goods and services that do not now exist. Another expert says that some day a television set will be available that can be hung on the wall like a picture. How much these developments might depend on phenolics is a question, but past performance indicates that the industry should gain in proportion to the increase of electrical and electronic equipment. But, along the same lines, use of phenolic in telephones has declined. Thermoplastics have invaded this field.

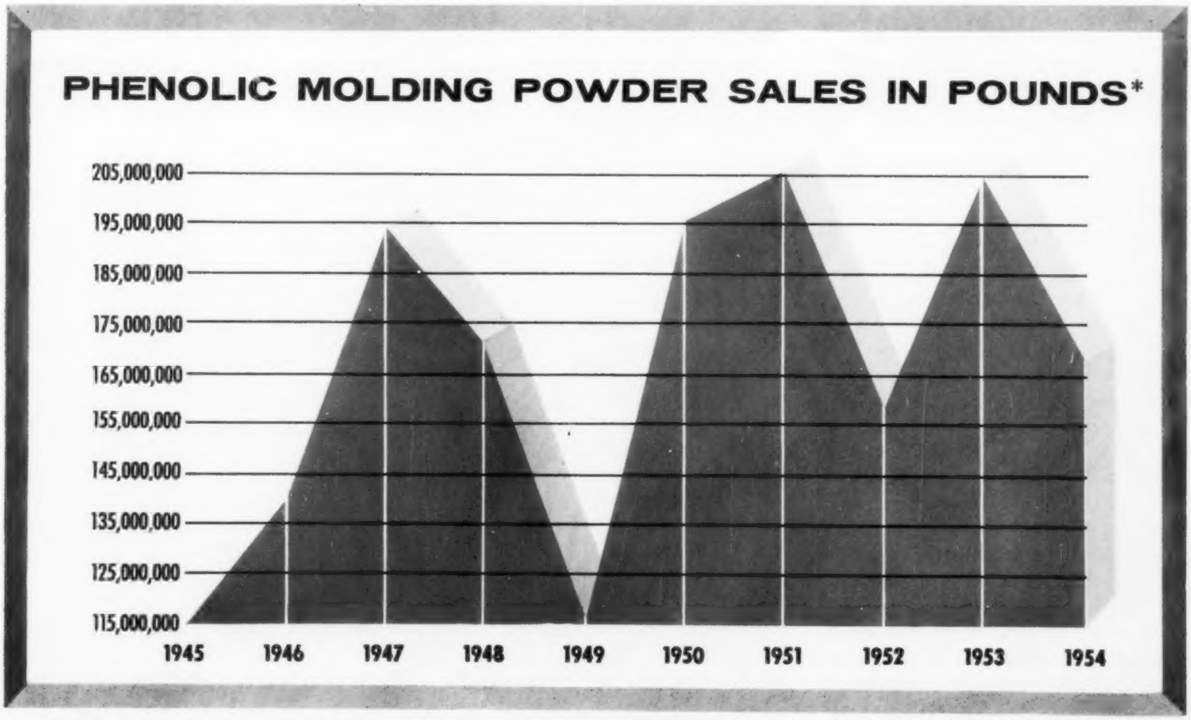
Wiring devices in phenolic declined, even though the housing and building field continued to grow. Big inventories and competition from other materials may have been the cause. An advertising campaign to sell colored urea wiring devices may have cut into phenolic poundage and rubber and molded vinyl electrical plugs moved into some parts of the industry in larger volume.

Use of phenolic in vacuum tube

Table III — Phenolic Molding Powder End Use Volume

End Use	1953 lb.	1954 lb.
Electrical control parts (panel boards, switch gear, etc.)	38,000,000	39,000,000
Housings, including television	40,000,000	17,000,000
Wiring devices	28,000,000	26,000,000
Closures	18,000,000	15,000,000
Utensil and appliance handles	18,000,000	14,000,000
Telephones	6,000,000	5,000,000
Washing machines	12,000,000	10,000,000
Automotive	8,000,000	6,000,000
Vacuum tubes	6,000,000	5,000,000
Miscellaneous[a]	30,000,000	31,000,000

[a] Miscellaneous included such things as caster wheels (3 million lb.); textile machinery; office equipment; buttons; camera parts (2 million lb.); toilet seats; vaporizers; and exports.



*Source: U. S. Tariff Commission, except for last 4 months of 1954, which is estimated.

bases was naturally down last year because television and radio sets sold in smaller numbers. But there can be little hope for increased use of phenolic in this application in the future because transistors, which require no base, seem destined to take over a great portion of the market in from three to ten years.

Washing machine agitators have been kicked back and forth between metal and plastics for the last four or five years—and automatic washers have added some kicks of their own. The early automatics of the tumble type didn't have agitators, but some of the later models have adopted them. The phenolic agitator business is spotty, depending upon which of the washer companies is selling the most machines. At present, two of the leaders are using agitators. Another encouraging sign is that several types of dishwashing machines have been equipped with miniature agitators.

Handles—Production of appliance handles was off in 1954 because appliance sales were way down. There

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UREA AND MELAMINE

DISHWARE continues as the big use for melamine molding material. Some analysts think that customer demand may have leveled off somewhat, but the number of molders that enter the field continues to increase, and there are still millions of families in the United States who are prospects for a set of melamine dishware. American Cyanamid, the original producer, does not disclose the amount of material being used, but people in the business guess that the 1954 volume of melamine molding powder was well over 15 million lb., or at least 2 million lb. above 1953. Less than 5 million lb. is thought to be for purposes other than dishware.

The Army is now circulating specifications for alpha-filled melamine and phenolic-modified, flock-filled melamine material. The Army was the first really big customer for melamine dishware. But, heretofore, the Army has always insisted on flock-filled melamine which was higher in cost than alpha-filled and more difficult to mold; the dishware design was sturdy but not very appealing to the housewife's artistic sense. If the Army eventually switches to alpha-filled melamine, molders who bid on Government contracts will be much happier.

Buttons—Melamine buttons are also increasing in quantity but volume is still quite small. At 47¢ a lb., melamine is one of the more expensive of the plastics materials commonly used for buttons, and although the product is superior, the cost affects consumption. Furthermore, polyester-glass buttons machined from extruded rod or sheet are cutting into the button market, especially for decorative purposes, men's sports shirts, and other spots where their iridescence and deep color are effective.

Melamine housings are small in number of applications, but there are some rather large-volume uses such as electric razor housings which shifted over to melamine two or three years ago and defied competition because plunger-molding permitted fast production with very few rejects.

Another promising outlet for the future is a melamine molded aerosol container, but it is still in the testing state.

A new glass-filled melamine with improved arc resistance is expected to step up electrical uses. Such a development has been long needed in the melamine field and could make quite a difference in applicability of melamine to various electrical purposes. It sells for 92¢, but even at that price it will compete with some of the other glass-filled thermosets,

Table IV—Urea and Melamine Resin Sales[a]

Use	1954 lb.	1953 lb.	1952 lb.	1951 lb.
Textile-treating and textile-coating resins	29,000,000	35,000,000	37,000,000	29,000,000
Paper-treating and paper-coating	17,000,000	22,000,000	23,000,000	18,000,000
Bonding and adhesive resins for:				
Plywood	69,000,000	51,000,000	—	—
All other bonding and adhesive resins[b]	21,000,000	43,000,000	—	—
Protective-coating resins, straight and modified	21,000,000	23,000,000	19,000,000	18,000,000
Resins for all other uses, including molding[c]	62,000,000	65,000,000	—	—
Adhesives	—	—	79,000,000	75,000,000
Molding, laminating, and miscellaneous[c]	—	—	63,000,000	75,000 000
TOTAL	219,000,000	239,000,000	221,000,000	215,000,000

Blank spaces are due to changes in classification; for example, melamine laminating resin is now included under bonding classification instead of in miscellaneous as in previous years.

[a] Source: U. S. Tariff Commission, except for last 4 months of 1954, which is estimated.

[b] This figure supposedly includes resin used for waste-wood bonding and melamine laminates, as well as commercial glues. Core binding resins are supposedly listed in "resins for all other uses."

[c] Includes filler for molding material.

NOTE: Total sales of all melamine and melamine-urea mixed resins in 1953, solid basis, was listed by Tariff Commission as 59,000,000 lb.; no 1954 figure is available.

and it is lower in cost than synthetic mica.

The industry is still talking about the possibility of a melamine made from urea that might cost less than 30¢ a pound. Researchers say it isn't feasible as yet, but if the day ever comes when it is, there will be a mild revolution in the thermosetting industry.

The urea molding powder business has been holding a fairly steady rate since 1950 and moves up or down according to the progress of all business. It still attracts the attention of regiments of researchers who inquire about its future, probably because so much urea crystal is now available in this country and folks are hunting for outlets.

Confusing Figures—The figures on urea and melamine molding powder in Table IV are confusing because the producers probably want them that way and because there has been a reclassification of end uses. Now that melamine laminating and bonding resins have been moved to another classification instead of being included with molding material, the figures make more sense; but it is still a mighty big puzzle to find out just what "all other uses," in the molding classification means. Our guess is that it means almost nothing.

Urea molding powder production is thought to have been somewhere in the 40 to 50 million lb. range for several years. The industry came out of World War II with a capacity of about 36 million lb. a year. Since then, capacity has been doubled, but it is believed that facilities are at least somewhat interchangeable with melamine production. In any case, the probability is that the industry has facilities and raw materials enough to produce sufficient molding material for any demand that can be foreseen in the next few years.

Urea Uses—The chief outlets for urea remain buttons, wiring devices, and closures, with poundage about equally divided but fluctuating slightly from year to year. It is possible that the purchasing level in these main outlets is going down to some extent now or in the near future, but the industry expects to pick up that loss in other outlets. Urea at 33¢ a lb., with a fairly heavy specific gravity and the necessity for compression molding rather than the faster injection molding, is higher in cost than many other plastics. Therefore, the industry treats it more or less as a specialty resin and must find outlets where its particular properties are more desirable than other materials and therefore a premium price can be expected. No one expects urea to become a big-volume material at that price, but those who are in the field do expect a steady business for years to come and have faith in the prospect of a gradual but not grandiose expansion.

Possibilities for larger molded pieces, for example, are being constantly explored. The most promising of these was the colored tele-

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CELLULOSICS

CELLULOSE acetate and cellulose acetate butyrate had another good year in 1954. Some folks were disappointed because there was no growth, but the prophets of doom who once predicted that these materials were on the way down should have red faces by now. The year wasn't the best ever enjoyed by this segment of the plastics industry but, compared to other plastics, it wasn't bad either. Raw material producers could wish that more of their capacity to produce had been called upon, but they are not moping around singing the blues. Acetate and butyrate may not have the great volume future of some of the other thermoplastics, but at least the past two years have given indication that they will level out on a good, substantial basis and that the possibilities of growth, especially in film, are by no means ruled out.

Total of film, sheet, and molding and extrusion material in 1954 was close behind the record year of 1953, and almost equal to the previous volume record of 108 million lb. in 1950. In addition to the amount listed in Table V, it is estimated that from 25 to 30 million lb. of film was used for still and movie photography and for X-ray purposes. These figures are not disclosed by the producers.

Molding and Extrusion—The combined molding and extrusion material volume of 73 million lb. in 1954 is well below the record of 83 million lb. of 1946 and the 80 million lb. of 1950, but it isn't too far behind 1953 and is well ahead of 1952 and 1951. The latter fact seems evidence that acetate has gained back much of the markets, such as toys, which moved over to other thermoplastics in the early 1950's. Some analysts think that polyethylene will edge into part of the acetate toy field, but producers point out that acetate has more color appeal and better rigidity. Their point is that acetate will hold or even increase its position in the toy field because of these factors, plus its great toughness, even though other thermoplastics are at a lower cost level.

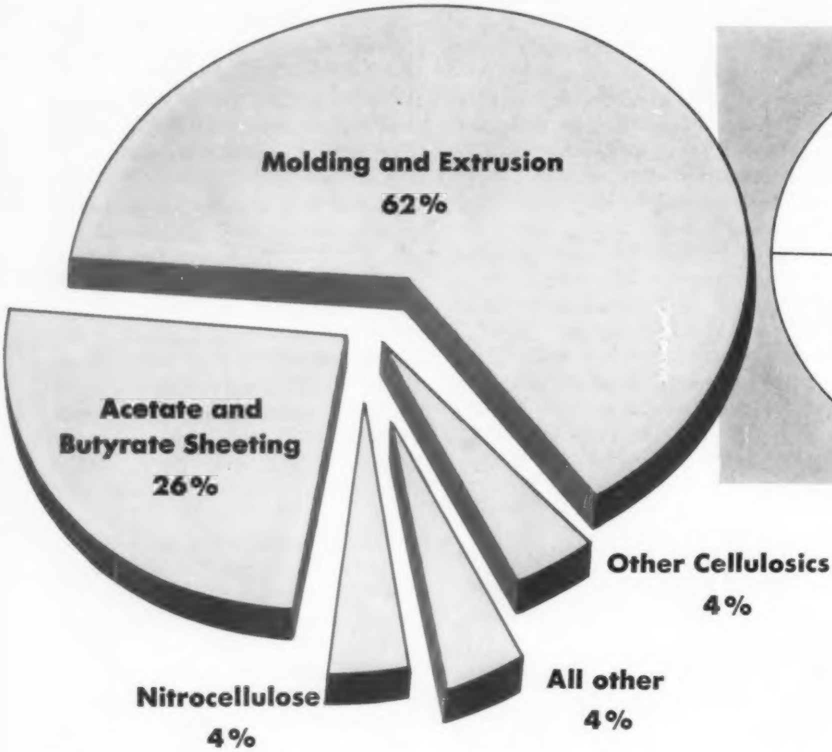
Sales of acetate and butyrate, in the first six months of 1954, were less than 35 million lb., in comparison to 39 million lb. in the similar period of 1953. When the August 1954 figure reached 6.5 million lb., the highest month of the year up to that time, there was some hope that 1954 might become a record year. (In other years August was only a medium month.) But the last four months were not high enough to overcome the low first six months of the year, generally blamed on a big inventory of finished goods carried over from 1953 and hesitancy on the part of some toy makers to place their orders. In October these same toy makers ordered fast and furiously—some of them waited so long that they couldn't get delivery in time to take care of Christmas business.

August sales were presumably high because of a threatened truck strike and also because some molders built up their inventories in the expectation of a large-volume fall business. The fall business did improve, but not enough.

There were few changes in the pattern of cellulose acetate molded products in 1954. Price per pound was about the same as the year before—41, 46, and 50¢ for opaque, regular, and transparent, respectively. Prices on reprocessed material went way down—sometimes lower than any other thermoplastic on the market—but demand was not great. The 41¢ price for opaque ma-

Consumption of Cellulose Plastics

1954



1953

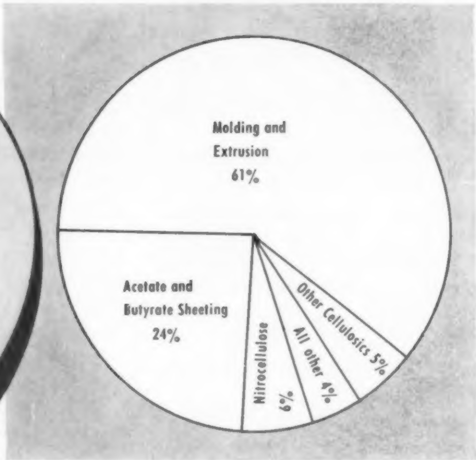


Table V—Cellulose Plastic Sales [a, b]

Classification	1954 lb.	1953 lb.	1952 lb.	1951 lb.
Cellulose acetate and cellulose acetate butyrate sheets:				
under 0.003 gage	16,900,000	17,200,000	11,400,000	15,100,000
0.003 gage and over	12,200,000	13,100,000	9,800,000	10,400,000
All other sheets, rods, tubes	5,200,000	5,200,000	5,000,000	5,200,000
Molding and extrusion materials	73,000,000	77,000,000	58,600,000	62,200,000
TOTAL	107,300,000	112,500,000	84,800,000	92,900,000
Nitrocellulose: sheets, rods, tubes	4,800,000	6,500,000	5,500,000	7,400,000
Other cellulose plastics, primarily ethyl cellulose	5,000,000	6,400,000	6,500,000	10,700,000

[a] Source: U. S. Tariff Commission, except for last four months of 1954, which is estimated.
[b] Includes plasticizers, fillers, and extenders.

terial is still not low enough to catch a great portion of the molding market that is going into high-impact polystyrene and to polyethylene.

Market Changes and Growth— There was an interesting change in the industry when dolls were switched from butyrate to acetate: a new lacquer for acetate was the reason. Beads produced from extruded acetate rod made a remarkably strong showing last year. Handles molded from a high grade acetate compound that will withstand the effects of boiling water made a decided imprint in the cutlery market. Housings for such things as knife sharpeners and mixers continued to increase in number, but the market is limited. An interesting new market was won by a cap or closure for aerosol cans of shaving lather on the basis of toughness and color.

Outdoor Butyrate Signs—The most exciting thing that happened in butyrate during 1954 was the introduction of a thick sheet that, used in outdoor signs, will withstand ex-

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POLYSTYRENE

HOLDING its own in 1954 was quite a feat for polystyrene when the record of what happened to most other plactics resins is consulted.

March and April, with sales volume of 30 and 29 million lb., respectively, were the high months of the year and led tc hopes of a 350 million lb. year for polystyrene; but a low of 20 million lb. in July and failure of the last six months to show much improvement over the first six months destroyed those hopes.

Some analysts are inclined to take the 1954 figure as an indication that the polystyrene business has leveled off, but the producers point to what went on in most other plastics as an indication that polystyrene did pretty well and they expect more widespread use of high-impact material to start the industry zooming upward again.

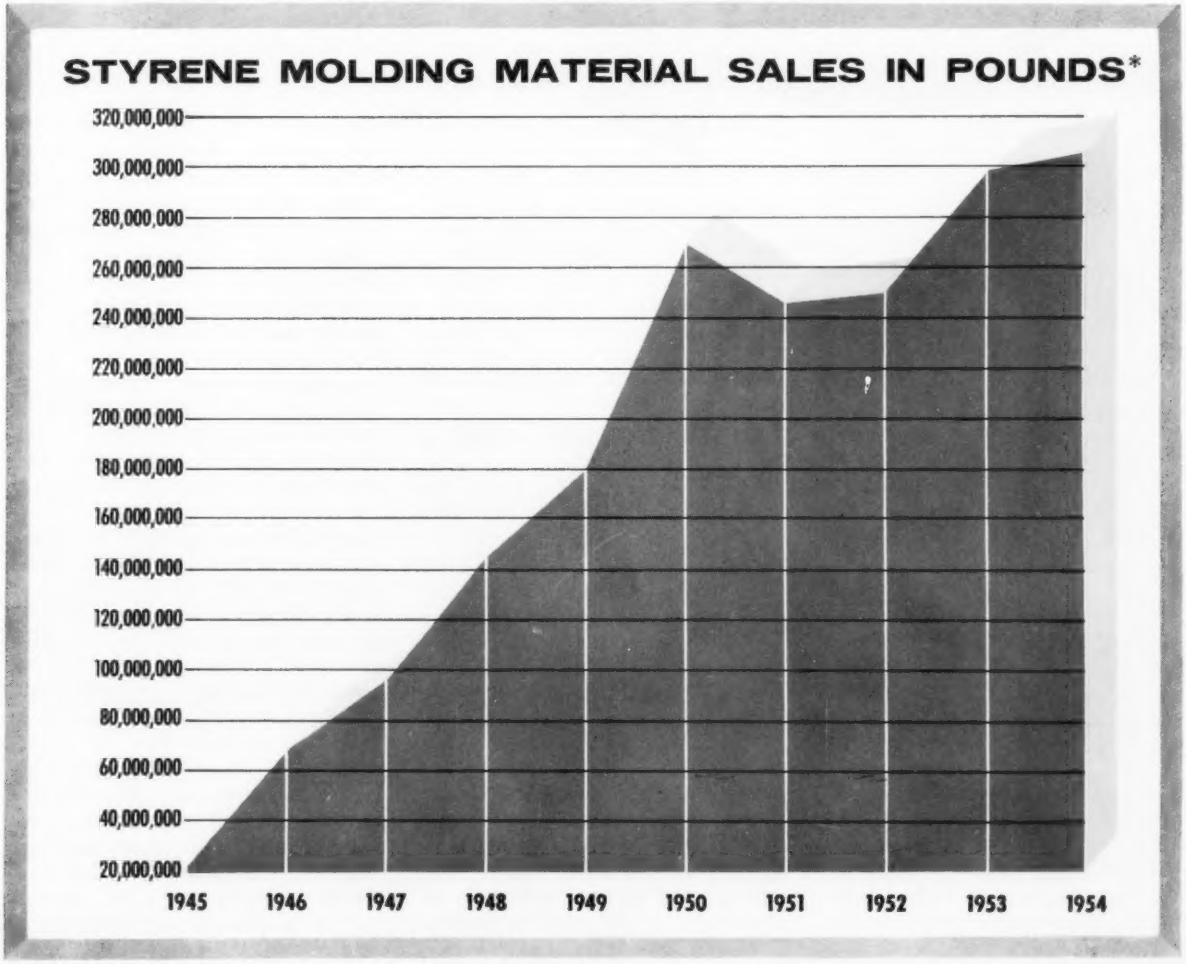
The graph on styrene sales below, does show a leveling off in 1954, but several years will have to pass before anyone knows whether or not it has become a permanent level or simply a point from which the curve will again shoot up—or start to decline. Except for 1952, when there was a bad half year, the halts or leveling off spots in the graph were caused by shortages of styrene monomer. Generally speaking, the overall advance shown in the polyethylene sales graph might even be termed sensational.

Styrene capacity 450 million pounds . . .

Goal Too High—Regardless of past statistics, there is no great feeling of exultation right now. Speakers for the industry, in pleas for more monomer during the Korean war, predicted that the industry would be selling from 400,000 to 600,000 lb. or even more of molding powder within four or five years. The industry started to build toward that goal but achievement hasn't materialized. Therefore, many of today's gripes about polystyrene sales are based on a goal that was set a little too high a little too early.

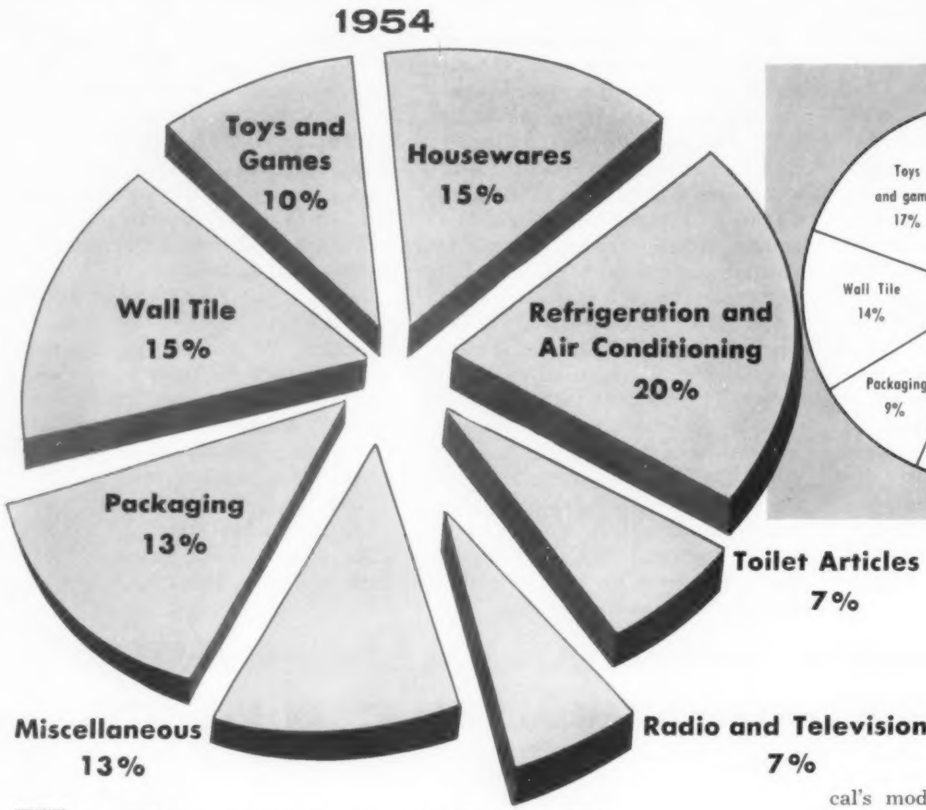
Many another industry would welcome a rate of growth such as that shown by polystyrene. There are some threatening factors that might possibly stunt future growth, and it just isn't logical to expect that polystyrene can keep on growing at its former rate, but the industry is far from stagnant. True enough, there is over-capacity in both material and processing equipment today, which means that overhead is plaguing management, but maybe that's good. Such a situation will help to shake down the industry and put it on a better management and financial basis.

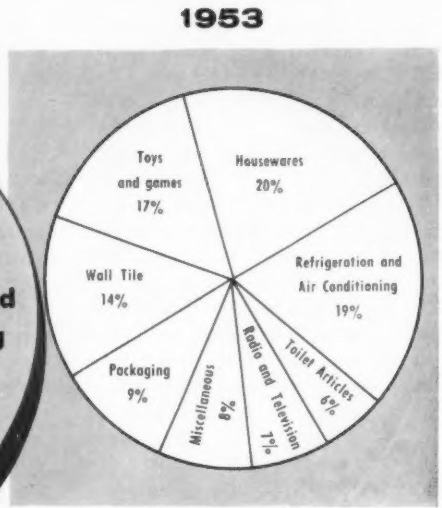
Capacity for producing polystyrene is now believed to be approaching 450 million pounds, including a few facilities which are not yet completed but should be ready to operate by the middle of 1955. Foster Grant's new plant, with a reported capacity of 20 to 30 million lb. started operation in mid-1954. Catalin has added 12 million lb. of capacity. Astra, a plant in New England that supplies only two or



*Source: U. S. Tariff Commission, except for last 4 months of 1954, which is estimated.

Polystyrene-Type Molding Material by End Uses*





*Source: U. S. Tariff Commission, except for last 4 months of 1954, which is estimated.

Table VI—Styrene Resin Sales[a]

Use	1954 lb.	1953 lb.	1952 lb.	1951 lb.
Molding materials[b]	305,000,000	298,000,000	249,000,000	245,000,000
Protective-coating resins[c] (straight and modified)	82,000,000	82,000,000	66,500,000	48,000,000
Resins for all other uses[d]	89,000,000	88,000,000	77,000,000	63,000,000
TOTAL	476,000,000	468,000,000	392,500,000	356,000,000

[a] Source: U. S. Tariff Commission, except for last 4 months of 1954, which is estimated.

[b] Includes plasticizers, fillers, and extenders; modified and copolymer molding materials; resin for foam. Not known whether or not new producer who came in during 1954 is included.

[c] Includes high styrene-butadiene resin for latex; also resin for styrenated alkyds.

[d] Believed to include resins for paper treatment; high styrene-butadiene rubber reinforcing resins; polyesters that require styrene; ion exchange resins; metal treating resins; miscellaneous.

NOTE: Quantity of high-impact polystyrene sold in 1954 estimated at between 120 and 130 million pounds. In addition, there was thought to be between 15 and 20 million lb. of styrene copolymers including that used in sheeting, such as Royalite, Boltaron, and Plio-Tuf. Somewhere between 20 and 25 million lb. of styrene type sheeting is thought to have been sold, or a 30% increase over 1953.

three customers, can produce 5 or 6 million lb. a year. On the other hand, certificates of necessity for Goodyear and Pennsylvania Industrial to build styrene plants apparently have been either postponed or dropped. The difference between a 300 million lb. sales volume and a capacity of 450 million lb. is probably enough to make potential newcomers take another look. Also to be considered are the styrene copolymers which are estimated as accounting for 18 million pounds. They are Bakelite's styrene-acrylonitrile, C-11; Naugatuck Chemical's modified styrene-acrylonitrile, Kralastic; Goodyear's styrene-butadiene, Plio-Tuf; and Marbon's copolymer, Cycolac.

New Type Monomers—Another facet of the situation is provided by new type monomers, similar to regular styrene, from which some interesting polymers may be derived at a later date. Dow's vinyl toluene plant has been in operation for many months, but no public statements have been made concerning development of new polymers therefrom. American Cyanamid has been flirting with the possibility of building a methyl-styrene plant for some time. Hercules will have alphamethyl styrene in small quantities as a co-product of their new-process phenol and acetone plant.

All of these plants must be considered as possible sources of more new styrene-type polymers which would add volume to the styrene-type molding powder industry. So far, their possibilities have been more closely linked to the coatings than to the molding industry, but chemists are unpredictable when they start mixing stuff in a test tube; they are not averse to producing a molding material as well as a latex.

Interest in high-impact materials continued during 1954. Producers feel that these hold the key to future expansion. Greatest volume is in modified polystyrene; the copolymer types are all higher in cost. Most producers designate it as a rubber modified polystyrene, but Dow, the major producer of this type of material, insists on labeling it simply as high- or extra-high-impact polystyrene.

Approximately 130 million lb. of high-impact material, apart from the aforementioned 18 million lb. of styrene copolymers, was sold in 1954, compared to an estimated 70 or 80 million lb. of impact and copolymer material in 1953. It could easily go to 150 million lb. in 1955, but general-purpose polystyrene seems destined to retain some 40 to 45% of the total polystyrene market for at least four or five years. After all, general-purpose material is low-cost, clear, and has a wide range of colors that makes it hard to equal for hundreds of applications. The only thing that might alter the situation rapidly would be the development of a clear high-impact material, but that possibility does not seem to be readily discernible in the immediate or foreseeable future.

Extra - High - Impact—Two producers have brought out an extra-high-impact polystyrene, but it sells for over 40¢; plain high-impact is only 2 or 3¢ higher than general-purpose polystyrene. The new extra-high-impact material is not expected to supersede previous materials in refrigerators and housewares but will be used in musical instruments, toys, pipe fittings, and wherever its higher strength characteristics are required.

Styrene-type sheet material is believed to have reached a total poundage of around 22 million lb. in 1954 or about a 30% increase over 1953. High-impact sheet alone was between 15 and 20 million pounds. The balance was copolymer material used for Royalite, Boltaron, and Plio-Tuf. One fabricator is reported to have used as much as 140,000 lb. of Kralastic for highway signs in the Rocky Mountain area where cowboys and youngsters love to shoot at them. The plastics signs do not have a tendency to feather out, as is the case with metal signs, punctured by bullets.

Signs and Short Runs—The big bulk of the styrene-type sheet is used for signs and short runs of specialty items. It sounds like a wonderful material for many other things, but a lot of research and marketing effort is necessary before it moves into new markets. Big growth could come in the housing and structural field, but the sheet metal industry is

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ACRYLICS

METHACRYLATE (acrylic) molding materials held up remarkably well in 1954 considering that automobile production was off over a million cars and that automobiles are the largest single outlet for these materials. Furthermore, sales of the materials were particularly large in late 1953 and early 1954. When general business declined, molders were caught with large inventories and naturally cut down on their orders until business started coming in again in late summer.

Production of molded automotive medallions and tail lights also aided the acrylic situation somewhat because individual pieces are becoming larger year by year as the designers take more advantage of the decorative and functional properties of methacrylates.

There was a slight price reduction in molding material in November but, at 68¢ a lb., methacrylate is still one of the higher-cost, more commonly used thermoplastics. There is a specialty compound at 65¢ a lb. used for compression molding and dental purposes, but the industry is waiting for improvement to be made in this material before it can be adopted to wide-scale use.

Jewelry and brush-back moldings declined early in the year, but the former picked up in the fall months. Nylon showed evidence of moving into a part of the brush-back business because it can be placed in boiling water for sterilization, but good quality brush backs will continue to remain a bulwark of the methacrylate industry for years to come because of its strength and beauty.

Industrial Parts—Medallions on refrigerators and other appliances continued to grow steadily and even won back part of the market that had shifted to lower-cost thermoplastics. Gage covers and molded parts for juke boxes and vending machines seem to increase slightly each year, although some of the methacrylate used for the latter is sheet. These molded pieces are listed as industrial parts and take from 10 to 20% of the methacrylate molding powder output.

Molded signs for outdoor use have failed to make the progress expected over the last few years. Sheet seems to be more practical.

Lenses for light diffusers in ceilings look as if they may be the next big volume use for molded methacrylate. A huge market in the light diffuser field has long been a goal of the methacrylate industry, but it has been mighty slow building up. The field is now being attacked from various angles and progress is good. The molded lenses are being heralded as the most satisfactory panels yet brought out for ceiling lighting purposes. In addition, there are extruded flat and corrugated sheet panels and cast sheet panels used in this work.

Exports of Plastics Materials First Six Months 1954

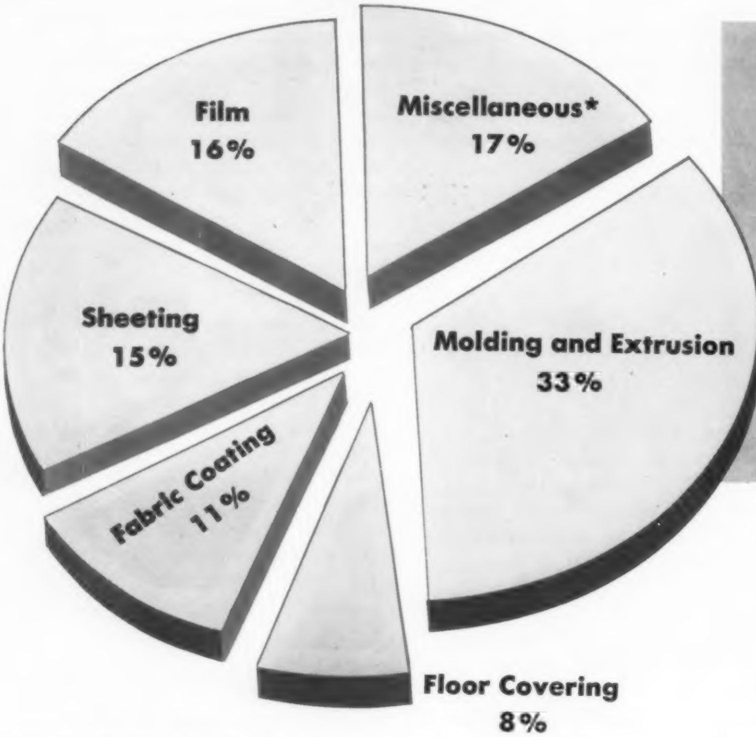
Material	Pounds
Polystyrene	13,900,000
Vinyl uncompounded[a]	13,400,000
Vinyl compound	4,600,000
Urea and melamine	8,000,000
Miscellaneous resins[b]	20,600,000
Vinyl film and sheet	10,300,000
Cellulose acetate	2,650,000
Vulcanized fibre	240,000

[a] Includes all types of vinyls.
[b] Includes polyethylene, coumarone, methacrylate, phenolic, and other resins not listed here.

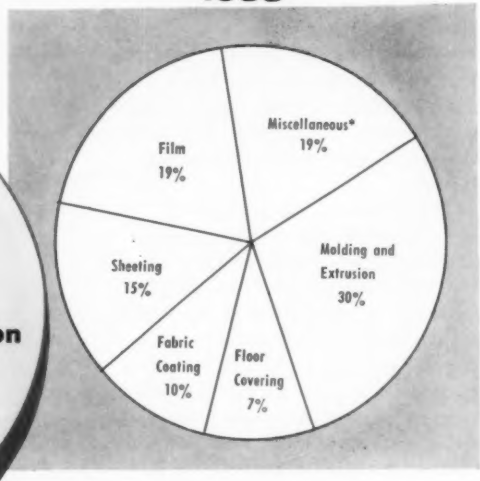
There exists a considerable amount of competition from plain and corrugated semi-rigid vinyl in panels and fixtures, and polystyrene is widely used in the egg-crate fixtures; but the methacrylates are gradually assuming large portions of the market. Still another metha-

Consumption of Vinyl Chloride and Copolymers

1954



1953



*Miscellaneous includes coatings, can linings, sprays, sponge, ink, adhesives, paper treatment, coating for glass yarn, exports, and items that cannot be otherwise classified.

Table VII—Vinyl Chloride and Copolymer Resin Consumption, 1951-1954

Use	1951 lb.	1952 lb.	1953 lb.	1954 lb.
Film under 10 mils	81,000,000	79,000,000	66,000,000	66,000,000
Sheeting over 10 mils[a]	67,000,000	74,000,000	60,000,000	65,000,000
Fabric treatment[b]	35,000,000	37,000,000	39,000,000	43,000,000
Paper treatment	6,000,000	7,000,000	6,000,000	7,000,000
Flooring[a]	——	——	25,000,000	32,000,000
Molding and extrusion	90,000,000	105,000,000	115,000,000	127,000,000
Protective coating[c]	——	——	22,000,000	24,000,000
Miscellaneous[d]	44,000,000	37,000,000	26,000,000	22,000,000
TOTAL	323,000,000	339,000,000	359,000,000	386,000,000

[a] Resins used in flooring were for the most part reported in sheeting in years before 1953.
[b] This figure includes latices and dispersions that are used for binders in non-woven fabric, prime coats for fabric before it is used with major coating, and similar uses.
[c] Protective coatings were reported in "miscellaneous" in years before 1953.
[d] This figure includes exports and resin used in various unclassified categories such as coated glass yarn, foam, vinyl chloride adhesives and small uses not identifiable. This figure is also an adjustment medium because of the complexities involved in separating vinyl resin uses into their various end use patterns; that is, the total over-all figure is fairly well established, but there is wide difference of opinion concerning the amount used for each end product.

crylate lighting fixture is the trough-like extrusion used in such large structures as the General Accounting Office in Washington, D.C., and the Broadway tunnel in San Francisco, Calif.

Extruded methacrylate sheet now looks well established after a couple of years of hesitation over economic and surface problems. It is available in various shapes and in widths up to 52 in. for glazing, lighting, and signs, but ⅛ in. seems to be the maximum practical thickness.

Claims have been made that a large part of all methacrylate sheet jobs, except those for the military, could be satisfactorily completed with ex-

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VINYL CHLORIDE

YEAR-END talk in the industry concerning vinyl chloride dealt more with the possibility of new producers entering the field than it did with how the vinyls fared in 1954 or the prospects for 1955.

The vinyl chloride industry consumed about 386 million lb. of domestically-produced solid resin in 1954 compared to a little under 360 million lb. in 1953. Some 20 million lb. of resin were exported and that market must eventually dry up to some extent since there are now between 10 and 15 resin plants in foreign countries. Furthermore, there are few, if any, market researchers who can foresee more than a 500-million lb. market for vinyl chloride within the next four or five years. The market increase after that is problematical, depending upon how many new applications are developed and how much competition is forthcoming from polyethylene, high-impact polystyrene, etc.

The strange factors in this situa-

tion are that there is already capacity for over 600 million lb. of resin in existence and that present markets are far from stable.

More than 14 companies have been rumored as considering entry into the polymer field and many of them even talk about producing monomer as well as polymer. The prospects in this list range all the way from large petroleum and chemical corporations to comparatively small companies now buying resin from current suppliers. Some of the latter indicate that they could combine resources to build one plant that would supply resin exclusively to the several owners.

Reasons for Talk—There are various reasons for all this talk. The larger companies that are interested are generally seeking outlets for their own raw materials such as ethylene or chlorine that are used in vinyl chloride production. The smaller companies claim that they might be able to make their own resin at less cost than they can buy it today. They furthermore assert that they would be protecting themselves against suppliers of resin who are also producers of products made from vinyl chloride resins.

Present suppliers point out that present vinyl prices are not guaranteed to remain at the present level forever; that small vinyl chloride production plants have never proven economically feasible in the United States; and that the cost of research alone is a back-breaker. Indeed, it is quite possible that most of the formulations now in common use will have been superseded in 10 years or sooner by formulations now under development.

More widespread use of acrylic esters in vinyl formulations is cited as just one example of radically different resins that will have to be considered. Present suppliers also point out that there is no such thing as a successful all-purpose vinyl chloride resin, which means that a new supplier would be compelled to install several types of equipment to meet the varying needs of calenderers, extruders, molders, and other customers.

However, the biggest deterrent of all for prospective new suppliers is the inability to foresee any big, new, or expanding markets, except possibly in flooring and unplasticized vinyl. In the latter case, even present producers will admit that they are working desperately to produce a resin that will be better than anything now available.

Growth Not Stopped—There is no tendency anywhere to believe that vinyl chloride has stopped growing, but the possibility of reaching the frequently predicted 700 or 800 million lb. sales volume in the near future is farfetched. Present forecasts indicate that a minimum of three or four years will elapse before even a 500 million lb. consumption volume is assured. At least the industry will have to show a greater ratio of increase per year than it has recently if that goal is attained.

MODERN PLASTICS' estimate on vinyl chloride sales in 1957, based on past performance, would be something like the following:

Film and sheeting	153,000,000 lb.
Fabric coating	55,000,000 lb.
Paper treatment	10,000,000 lb.
Molding and extrusion	175,000,000 lb.
Flooring	60,000,000 lb.
Protective coating	32,000,000 lb.
Miscellaneous	30,000,000 lb.
TOTAL	515,000,000 lb.

There are many guesses and ifs in the above figures, but unless something unusual happens in the development of new products, a hope for bigger markets is like whistling in the dark. And even these prognostications are based on a faster rate of growth than the industry has been showing in the past three or four years.

Not even a radical decline in the price of resin is likely to broaden the markets to any marked degree. A bigger upsurge in rigid vinyl than now expected could increase the sheeting and extrusion classifications, but such a development may not come until along about 1960. Technical improvements such as a higher heat-resistant resin; elastomeric resins that require no plasticizer; and film that will actually breathe and still remain waterproof would help. Even so, several years are generally required for such radical improvements to catch hold.

The tabulations in Table VII indicate that the total vinyl chloride consumption in 1954 was less than 400 million pounds. All the sub-totals in this table vary somewhat from those published by the United States Tariff Commission and are based on MODERN PLASTICS' estimates reached

Table VIII—Uses for Vinyl Film and Pattern of Consumption, 1953-54

Uses	1953	1954
	lb.	lb.
Draperies, bedspreads, kitchen and bathroom curtains	23,000,000	16,000,000
Yard goods	10,000,000	9,000,000
Closet accessories	6,500,000	7,000,000
Shower curtains	6,000,000	5,500,000
Nursery goods	4,000,000	5,500,000
Table covers	4,000,000	4,500,000
Appliance covers	3,000,000	2,500,000
Furniture covers, indoor and outdoor	3,000,000	3,500,000
Rainwear	10,000,000	9,000,000
Baby pants	3,000,000	3,500,000
Aprons, including industrial	1,500,000	2,000,000
Miscellaneous wearing apparel	3,000,000	2,000,000
Industrial, including film for laminates used in outerwear, and automotive and other upholstery	7,000,000	10,000,000
Miscellaneous	10,000,000	10,000,000
TOTAL	94,000,000	90,000,000

NOTE: In this table an attempt has been made to include film only under 8 mils in thickness for 1954. The 1953 figures include a small amount of 8 and 10 mil material. Inflatables are not included. Figures can be only approximations, since accurate statistics are not obtainable. See text, p. 187.

as a result of personal interviews with key personnel in the industry. The Government's figures for vinyl chloride are based on a complex system of ratios and percentages whereby each resin producer must estimate the amount of resin for each end product by past performance. Because of the complex nature of the vinyl industry, the task is much more difficult than dividing up the amount used for various end uses in other plastics materials, and the margin of error can be much greater.

Why Figures Differ—The sum total of resin consumed is about the same in the estimates by MODERN

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NYLON

NYLON molding material moved along at a good rate in 1954, but big volume progress is slow because most nylon moldings are small parts that must be specially engineered for each job. It is believed that about 12 million lb. were used for molding in 1953. One estimator guesses the 1954 figure at 15 million lb., which would be a mighty big increase. In addition, there are several million pounds used for bristles in tooth brushes, paint brushes, and industrial brushes.

There are now probably more than 100 molders working with nylon but it is doubtful that there are more than 15 or 20 who use more than 3 or 4 thousand lb. a month. There are also a large number of captive plants, the outputs of which are entirely used in products manufactured by the owners. General Motors, for example, is one of the larger customers for nylon.

One of the most important announcements of the year concerning nylon was that Du Pont had brought out a new formulation which will withstand outdoor weathering. Previous formulations were not particularly recommended for outdoor uses.

Nylon is most generally used for small bearings, bushings, valve bodies, and other wearing surfaces. In short, it is largely considered as a replacement for small machined metal parts where its working heat resistance of up to 350° F., toughness, and self-lubrication qualities are desirable.

Uses Expanding—Automobiles are now using an estimated average of ¼ lb. of nylon per car for such parts as dome light covers, door catch components, speedometer gears, and small bushings or bearings. Experimental work now in progress may soon make it possible to record the average per car in pounds rather than fractions.

Practically every refrigerator now being made has a nylon door-latch roller. Bodies on the hot and cold water mixing valves in washing machines are now being molded of nylon. Two nylon valve parts are being used in aerosol containers. Nylon is even under study for aerosol containers. Nylon brush backs are becoming common wherever sterilization is desirable. Linotype gears are getting the nylon treatment and printing plates are another possibility. A fountain pen barrel and mechanism looks good in nylon. Parts for agricultural machinery seem to be on the way. Drapery traverse rods in the home require no lubrication or maintenance when nylon is used in components. Even race horses are running on nylon. The latter project was dreamed up by some ingenious soul who claimed that his horse cut a second off its mile record by using light weight nylon horseshoes. The list goes on indefinitely—by the end of next year it will unquestionably be much longer. Du Pont is reported to be evaluating the possibilities of using nylon in about 1000 products!

There are many formulations of nylon, some of which are not thought of for molding applications but they are plastics nevertheless. One is used in the jacketing on the Army's assault wire. Another goes into monofilament for fishing lines. And wire insulation takes a good sized quantity of still another formulation.

Competition—The rather rapid strides made by nylon has attracted competitors. First to announce actual production and sales in the U. S. is National Aniline, whose product will be sold through the Barrett Div. of the parent company for both, namely Allied Chemical & Dye Co. But the National Aniline material is somewhat different from Du Pont's nylon or Zytel as it is now called. The National Aniline material is caprolactam. In Europe the Du Pont type nylon is called nylon 6,6 and caprolactam is nylon 6 or Perlon.

In addition to Barrett, the following companies are now offering nylon 6 to molders in this country through import channels: Hercules,

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POLYETHYLENE

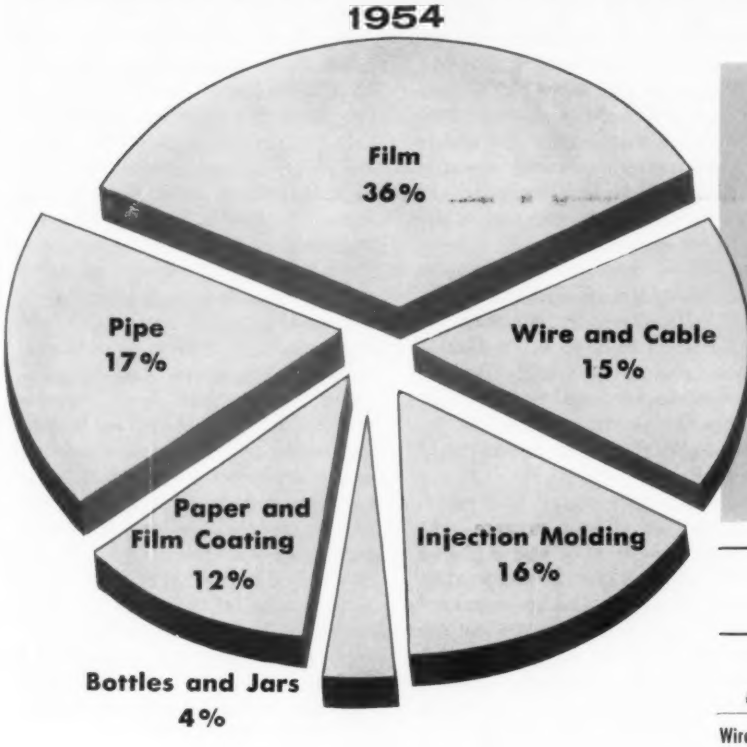
FOR PRACTICALLY the first time since it came on the market, polyethylene was in free supply throughout most of 1954. From a production rate of about 15 million lb. a month at the end of 1953, the industry could supply material at a rate of about 26 million lb. a month by the end of 1954, with lots more coming in soon. Since polyethylene is now being consumed at a rate of 16 or 17 million lb. a month, some persons are already beginning to sweat over sales problems.

MODERN PLASTICS' estimate is that somewhere near 300 million lb. of polyethylene will be sold in 1955 or an average of 25 million lb. a month. What will happen in 1956 is still problematical. The trend will be up, but how much up will depend on what happens in 1955. An interesting sidelight on this situation is that sales of extrusion machines were up in 1954 over 1953, a great portion of the increase being in the large sizes (See p. 122). How many will be used for polyethylene is not known, but one can guess that it will be over half.

A new entrant in the polyethylene field in November was Tennessee-Eastman. In that month the company announced that its $8 million plant in Longview, Texas, was ready to deliver at a rate of 20 million lb. a year. Present announced annual capacity of Union Carbide (Bakelite) is 190 million pounds. Estimated capacity of Du Pont is about 100 million pounds.

Outstanding feature of the Tennessee-Eastman announcement was the statement that the material will

Estimated Polyethylene Consumption, by End Uses



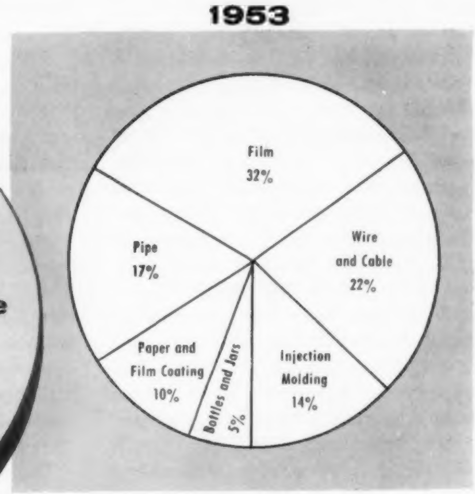


Table IX—Estimated Consumption of Polyethylene, by End Uses

End Use	1953 lb.	1954 lb.
Wire and Cable	32,000,000	30,000,000
Film	45,000,000	70,000,000
Pipe[a]	24,000,000	32,000,000
Paper and Film Coating	15,000,000	23,000,000
Bottles and Jars	7,000,000	8,000,000
Injection Molding	21,000,000	32,000,000
TOTAL	144,000,000	195,000,000

[a] This figure does not include scrap which is estimated to be at least 6 million lb. in 1954. Total reworked polyethylene used for all purposes in 1954 is thought to be around 20 million pounds.

be made in the form of spherical pellets for ease of processing.

Added Starters—The battalion line-up of new companies that may start production of polyethylene in 1955 is as follows:

Monsanto is expected to announce any day that its new 60 million lb. plant is on stream.

Spencer Chemical Co. is expected to be ready for delivery of material in April—perhaps sooner. Capacity is announced as 45 million pounds annually.

Dow Chemical Co. and National Petrochemicals both expect to be in commercial production by mid-summer. Capacity of each plant is estimated at 25 million pounds.

Koppers Co. plans to have its 25 million lb. plant in operation about September.

Bakelite expects to have its fourth plant in California on stream in the third quarter, with an announced capacity of 60 million pounds.

If all the above plans materialize, the annual capacity of the industry will be 550 million lb. or 46 million lb. a month by the end of 1955.

In addition, Monsanto has stated that it will build a second plant in the near future. And then there is Phillips Petroleum which has stated that the company expects to enter the field in about two years with a new low - pressure process. The Phillips material is reported to be more rigid than any polyethylene now on the market. Company literature states that it will have a tensile strength of 3700 p.s.i. compared to around 1800 for standard polyethylene and that it will withstand a 30° higher temperature, thus permitting sterilization. It will be known as Marlex 50. Not a hint has been dropped by Phillips as to how its low-pressure method will affect the over-all polyethylene price structure.

Despite all this tremendous expansion, it is believed that a few other companies are still planning to enter the field within the next five years. Several of them are withholding decisions until they find out what's going to happen in disposal of the Government's rubber plants. They are not concerned about any possible competition between rubber and polyethylene but are concerned about adding expensive new facilities to their organizations until they find out whether or not their possible expansion in the rubber and rubber chemicals field may not be all that they can swallow in one gulp.

Prices Coming Down?—Nearly everyone in the industry expects polyethylene prices to come down in the future, but no one knows when. Bakelite has let it be known that it can foresee a day when price will be much lower. Competitors are all aware of that factor and have undoubtedly planned to meet such a situation.

Present basic prices are 41¢ per lb. in quantity lots for molding grade, 43¢ for film grade, and from 46¢ up for electrical grade. The

Film competition getting fierce . . .

price for colored polyethylene is 50¢ in quantity lots.

Sales of polyethylene in 1954 were satisfactory, even though this was the first year in which all the material that could have been produced was not sold. The new capacity, counting that which came in late in 1953 and excluding the Tennessee-Eastman increment, was about 160 million lb. or more than the entire industry used in 1953 (Table IX).

Since there was never enough material to supply demand in other years, it is reasonable to believe that equipment to handle the big new supply was not yet in place. Furthermore, processors didn't have much chance to develop new applications because they couldn't get enough material to supply established markets.

Boosting 1954 polyethylene sales by 50 million lb. over 1953 was quite an accomplishment in a year when all other major plastics declined or barely managed to hold their own. Furthermore, there was a large quantity of scrap put into the market. Some estimators think it amounted to from 20 to 30 million pounds. Large portions of this material went into pipe, but this type of scrap should not be counted with the B grade polyethylene which producers sell directly to pipe extruders and count as virgin material. Film scrap will probably be large for some time to come since users have become more choosey and won't accept material that contains fish eyes or is of irregular gage. The old days when they would take anything they could get are gone forever.

Film sales increased by about 60%, a much larger percentage than the over-all increase for polyethylene. One reason, of course, is that the film market had been already well established and was only waiting to be expanded. It will expand many times more in the years to come. Most researchers think that the Modern Plastics estimate (Table X) of 70 million lb. for film in 1954 is low—maybe 10 million lb. low—but our own sources have been reliable in the past and we lean toward conservatism in estimates of this sort.

There are now at least 35 producers of polyethylene film and competition has become fierce. The specter of degrading the film to meet competitive prices has already reared its ugly head. Improper applications constitute another evil.

But, generally speaking, progress has been good. Uses have spread from food packaging to almost every type of retail merchandise. The film has given a terrific uplift to the use of help-yourself racks in drug stores and other outlets where customers can handle the polyethylene packaged goods without soiling them. Dry goods in department stores are now commonly packed in polyethylene. Travelers use polyethylene bags to protect clothing packed in luggage. Laundry is moving in 1½ mil thick bags.

Big as these uses are, they are still infinitesimal compared to potentials. Retail outlets are far from saturated with uses for polyethylene bags.

In Food Packaging—The food field, where polyethylene film made its first big impact, is still wide open for many million more pounds. At the Produce Show in Washington, D.C., last fall, it was pointed out that 75 billion lb. of fresh produce was sold in the United States in 1953 and that only 10 to 15% of it was prepackaged. Polyethylene and other plastics films have a chance for innumerable outlets in that field. Packaging of lettuce is an outstanding possibility, if and when the packaging industry can learn how to prevent the top leaves from becoming brown. One of the California cooperatives is now enclosing polyethylene bags in each crate of lettuce so that the retailer can package each head when put on display. Another idea is to line the crate with polyethylene before shipment. Some experts believe that the lettuce problem may be overcome if the film is used as a wrapper instead of a bag.

Another example with good possibilities is wrapping individual pears and apples in polyethylene. One film producer has developed a shrink-type polyethylene that can be used for frozen poultry.

There are many uses for film other than food packaging. Tarpaulins for covering machinery and painters' drop cloths are examples. It can be used as an underground barrier on concrete slabs around poured basements. Farmers are using it to lay down between rows of strawberries and vegetables to prevent weed growth and save berries that fall off the plant. It can be used for trench silos and as irrigation ditch linings. Industrial uses such as drum liners for hygroscopic materials are already well established, but could get much larger. Furniture manufacturers are using it to line vinyl upholstery on the underside to prevent lacquer migration from wood to vinyl. Closet accessory manufacturers use it to line their vinyl garment bags and other products. The field is so big that it seems impossible to try to project future growth, for no one knows where new and bigger applications will turn up. One prospective producer has estimated that 160 million lb. of polyethylene will be used for packaging

(*To page* 194)

Table X—Estimated Polyethylene Production

Year	Total lb.	Portion Converted to Film lb.
1948	15,000,000	Not available
1949	31,000,000	"
1950	48,000,000	"
1951	80,000,000	"
1952	95,000,000	27,000,000
1953	144,000,000	45,000,000
1954	195,000,000	70,000,000

Application Progress: 1954

FROM the standpoint of plastics applications, the year 1954 started with the score in its favor.

The preceding year, 1953, had ended on a high note of optimism. Two significant application trends had dominated that year's activities: first, growing awareness on the part of industrial designers of the advantages inherent in the use of plastics as prime engineering materials and, second, major emphasis on the use of the newer plastics materials and the newer processing techniques to broaden the bases of plastics applications (MPL, Jan. '54, p. 81).

Building on these two trends, the plastics industry in 1954 made substantial advances in developing new uses for plastics materials and expanding existing ones. Where 1953's activities were largely devoted to investigating the possibilities of the newer materials and the newer techniques, the year 1954 witnessed the successful transition of many of these innovations from testing stage to commercial production line.

Progress in vacuum forming—certainly the dominant development in plastics processing techniques in 1954—perhaps best typifies this transition.

In 1953, interest in the new technique ran high but only a limited number of vacuum forming machines were in actual operation and these were concentrated primarily on small quantity runs in the toy and novelty, sign and display, and appliance fields. In 1954, stimulated by improvements in automatic forming equipment and the introduction of better and low-cost rigid plastics sheet materials, vacuum forming swept through the plastics industry like a prairie fire. By the end of the year a number of applications, such as refrigerator door liners and parts, automobile accessories, huge displays, packages, and lighting fixtures, had developed into large-volume markets which absorbed more plastics materials than ever before in their history (MPL, May '54, p. 87).

Similar development was noted during the year for other processing techniques. Slurry preforming, for one, was an outstanding example. In 1953, this new process of making preforms for reinforced plastics products was still in the experimental stage and being evaluated by the Quartermaster Corps of the Army for making military items (MPL, Nov. '53, p. 99); in 1954, the process was adapted to the mass production of a new line of high quality luggage (see p. 87). The success of this work stimulated the manufacturers of reinforced plastics boat hulls, auto bodies, furniture, structural members, etc., to a new

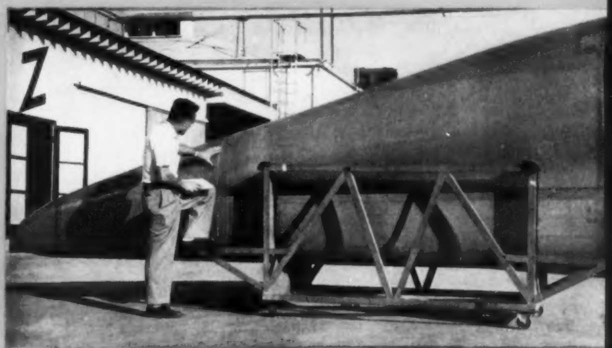
(*To page* 197)

...in airplanes

RECOGNITION OF PLASTICS AS A SOUND structural material for the aircraft industry was given a decided boost in 1954 by the introduction of several large fuselage sections fabricated of polyester-fibrous glass laminates.

One of the most successful of these was a 17 ft. long "stinger" tail made up of sandwich materials—a laminate face with an impregnated fibrous glass honeycomb core—for the U. S. Navy's Neptune patrol bomber (MPL, Dec. '54, p. 100). As an example of how plastics can help to simplify the ever-increasing complexities of modern aircraft design and performance, the production of the tail was one of the year's high-spots. In addition to the obvious physical advantages of the reinforced plastics tail—light weight and strength—the structure was produced in considerably less time and with more economical tools and equipment than would have been required to make an equivalent metal part.

Plastics also dominated many of the year's developments in non-structural aircraft applications. This was especially evident in the substantial increase in use of new foamed plastics as insulation and as a core material to fill hollow wing sections (MPL, Dec. '54, p. 87 and p. 100). In interior decoration, airplane seat side panels and arm rests formed from styrene copolymer sheets came in for major consideration by commercial airlines.

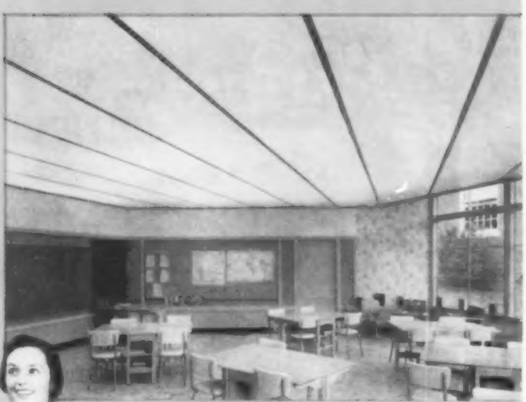


Stinger tail, 17 ft. long, is one of the first large reinforced plastics fuselage sections to be made on mass production basis

Photos courtesy Zenith Plastics Co.

Lightweight, rugged tail incorporated as an integral part of modern aircraft design contributes to improved performance

...in lighting



Courtesy Monsanto Chemical Co.

Luminous ceilings—a big new market for plastics—are made up of formed vinyl or acrylic diffusers suspended below true ceiling

Modern bullet-shaped lamp shades that won't chip and are easy to clean are molded in one piece of phenolic

Courtesy Lightolier

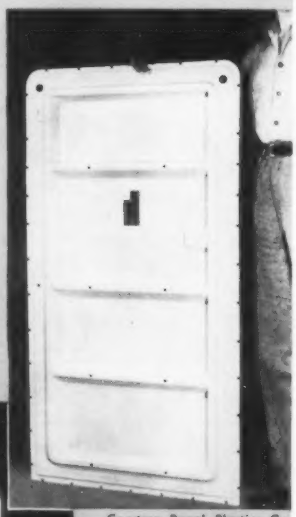
MAJOR CONTRIBUTING FACTOR TO THE ADvances made by plastics in the lighting field in 1954 was a significant shift in design emphasis by lighting engineers. Instead of concentrating on adapting conventional materials to conventional types of fixtures, the lighting industry placed primary emphasis on the creation of smart new fixtures more efficiently suited to the needs of modern living.

In nearly every case, the application developments born of this kind of thinking involved major uses of plastics materials. Ultra-modern bubble-shaped and star-shaped lamp shades fabricated of flexible vinyl sheeting, and handsomely-styled bullet-shaped lamp shades molded in one piece of phenolic to harmonize with contemporary interior decoration, were among the many 1954 innovations in lighting fixtures (MPL, June '54, p. 134).

On a larger scale—but still in tune with the emphasis on smart efficiency—millions of square feet of vinyl and acrylic sheet in the form of light diffusing panels were used in building construction and modernization plans during the year. The architectural possibilities of these materials for lighting systems were further enhanced by improved fabrication techniques which enabled the sheeting to be vacuum formed into panels with three-dimensional raised patterns for special lighting effects or to be corrugated in continuous rolls for use in the important new "luminous ceiling" type of lighting (MPL, Dec. '54, p. 110).

...in refrigerators

Inner door liners were vacuum formed in 1954 of glossy high-impact styrene sheeting with improved surface finish



Courtesy Regal Plastics Co.

Because the molded vinyl drain rail (arrow), 4½ ft. long, is flexible, it fits snugly against the walls of refrigerator food compartment directly beneath the chill shelf

Courtesy B. F. Goodrich Chemical Co.

USE OF PLASTICS AS A PRIME MATERIAL IN the refrigeration industry took on added importance in 1954. In addition to the record number of major components designed exclusively for plastics that appeared in the 1954 model refrigerators, developments in materials and techniques point to at least a fourfold increase in plastics usage by the refrigeration industry within the next decade.

Dominating activities during the year was the general change-over by manufacturers from inner door liners and trays fabricated of paper laminates or injection molded of styrene to liners and trays vacuum formed from glossy, high-impact styrene sheeting (MPL, May '54, p. 87). Originally, the decision to switch to vacuum formed sheet for the applications was prompted by the low tooling costs offered by the process. As the industry became more familiar with the technique, however, marked advances in surface finish, intricate detail, and depth of form showed up to give the vacuum formed parts an added edge over other types of liners and trays.

Less dramatic, but equally important as an indication of the potential market for plastics in the refrigeration industry, was the use being made of elastomeric vinyl parts in the 1954 models. Highlight of these activities was the introduction of a 4½ ft. long molded vinyl refrigerator drain rail (MPL, Feb. '54, p. 110). Weighing 21 oz. and incorporating an integral water spout, the piece attracted attention as one of the largest and most complicated refrigerator parts ever molded of vinyl.

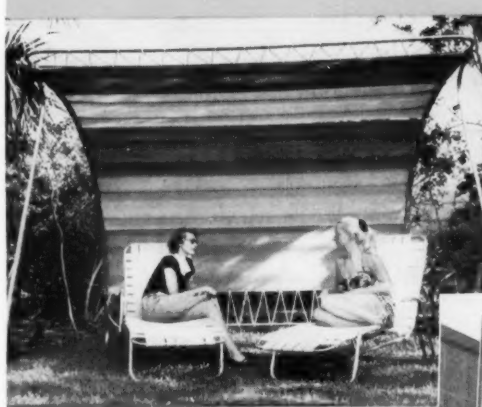
...in building

As a potential market for plastics materials, especially polyester-fibrous glass laminates in the form of structural or glazing panels, the building field took on large-volume proportions in 1954. Although activities covered a broad front—including expansion of use of acrylic glazing—new developments in tailoring reinforced plastics panels to meet specific end-use requirements captured most of the attention of architects, builders, and decorators.

These developments took several forms. A number of fire-resistant polyester resins, for example, were formulated to overcome building code limitations. Surface texture and coloring, as well, were considerably improved during the year by the perfection of techniques for molding a pebble-grain finish on the face of the panel and for laminating decorative materials between layers of the fibrous glass.

One manufacturer also announced a method of coloring panels for dramatic and practical light control. Each of the panels in a series is identical in color, but the range in light transmission values for each complete series runs from as little as 5 to nearly 60 percent (MPL, Feb. '54, p. 83).

Another noteworthy innovation of 1954 was a new type of panel press-molded with a modular rib pattern instead of conventional corrugations (MPL, Nov. '54, p. 100). To simplify installation, the ends of the ribs are tapered so that each individual sheet fits perfectly under the overlapping sheet.



Courtesy U. S. Rubber Co.

Garden cabana is made up of 9 ft. long translucent reinforced plastics panels produced by Russell Reinforced Plastics Corp.

Press-molded reinforced plastics structural panels designed with modular rib pattern are used as structural sidings for buildings

Courtesy Chemold Co.

...in luggage

Activities in the luggage field in 1954 indicate that reinforced plastics luggage will reach its full sales potential much sooner than anyone had anticipated.

Production of this type of luggage was on a relatively limited scale prior to 1954, but the developments that took place during the year in refining fabricating techniques stimulated manufacturers already engaged in making reinforced plastics luggage to expand their lines and encouraged more users of conventional materials in luggage manufacture to enter the field.

Improved methods of matched metal molding, coupled with such newer processes as slurry preforming, helped lower costs of the end products and made faster production lines possible (MPL, Oct. '54, p. 102).

In designed appearance and performance, 1954's models also had the edge over experimental versions of previous years. For those luggage manufacturers who used the natural "jack straw" pattern of the fibrous glass as the surface finish, special glass mats were made to heighten the effect; for manufacturers desiring more conventional surfacing effects, a method was developed in 1954 for molding a vinyl-coated cloth directly on the reinforced plastics shell.

Also of prime interest to the future plans of the reinforced plastics luggage industry is the fact that manufacturers in 1954 backed up sales with aggressive merchandising campaigns planned to familiarize consumers with the basic advantages of the luggage.

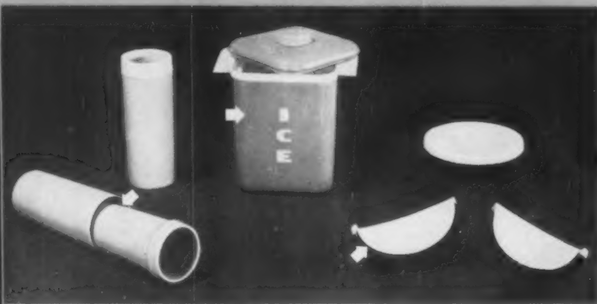
New slurry preforming technique is used in mass production of reinforced plastics luggage which is surfaced with vinyl-coated cloth

Courtesy American Tourister

Another type of lightweight matched-metal molded luggage uses the natural "jack straw" pattern of the laminate as the surface finish

Courtesy H. Koch & Sons

...in housewares



Courtesy Dow Chemical Co.

Air spaces (arrows) insulate "double-wall" tumblers (Gits Molding Corp.), ice bucket (Columbus Plastics Products), and salad bowls (Federal Tool Corp.)

Courtesy Bakelite Co.

Functional polyethylene housewares introduced in 1954 included versatile basin (Beacon Plastics)

VYING FOR POSITION IN THE HIGHLY COMPETitive buyer's market of 1954, plastics housewares manufacturers wooed consumers with high-quality products that were more solidly constructed and better engineered than those of recent years. Improved design entailed thicker wall sections and molded-in supporting ribs did much to expand the sales potential of established plastics housewares. And the availability of better plastics materials and new production techniques stimulated interest in the possibilities of extending the use of plastics into new housewares applications (MPL, June '54, p. 126).

One trend that presaged just such an extension in use was noted in the increasing adaptation of "double-wall" design to several new plastics kitchen articles (MPL, Dec. '54, p. 117). These double-wall items are molded as two separate shells which are then cemented or fitted together with an air space between the two parts to provide efficient thermal insulation.

Strongest trend in the housewares field in 1954, however, was towards the use of the newer and tougher plastics in those articles that are ordinarily subjected to considerable abuse. High-impact styrene alloys, in particular, found increasing application and flexible housewares hit a record high in number and variety. Statistics indicated a three-fold increase in polyethylene housewares sales from 1953 to 1954; enthusiastic consumer acceptance gives rise to the expectation of a nine-fold increase by 1960 (MPL, Oct. '54, p. 91).

...in housings

Colorful styrene housing improves appearance and performance of adding machine

Courtesy Clary Multiplier Corp.

Successful use of formed vinyl-steel laminate as housing for business machine introduced new design concept to the field

Courtesy International Business Machines Corp.

WHILE HOUSINGS OF ALL TYPES HAVE LONG been a large-volume market for plastics, it has only been recently, with the introduction of newer plastics and improved processing techniques, that housings designed especially for business machines have taken on major importance. In 1954, much of the interest in such housings centered around the use of the high-impact styrene alloys and polyvinyl chloride sheet.

Colorful styrene alloys—combining attractiveness with the durability and shock resistance necessary to withstand normal office abuse—came into wider use in 1954 in housings for portable hand-operated and electric calculating machines. One manufacturer had only one styrene-housed adding machine in its 1953 line (MPL, Oct. '53, p.106); so enthusiastic was consumer acceptance that, in 1954, steps were taken toward a complete change-over to styrene housings for the entire line.

Even greater market potential, particularly in the larger computing machines, was predicted for housings formed from the new structural laminations of sheet steel and polyvinyl chloride sheet. Used in previous years for such minor applications as railroad car rests and parts for aircraft interiors, the rugged, easy-to-maintain material was adapted for the first time on a large-scale commercial basis in 1954 for housing machines produced by a leading business machine manufacturer (MPL, May '54, p.107).

WHILE THE VOLUME OF PLASTICS GOING INTO established industrial markets continued to climb at a steady, normal pace in 1954, use of plastics in two specialized phases of industry—for tooling and as a backing for pressure-sensitive tapes—expanded at a fantastic rate.

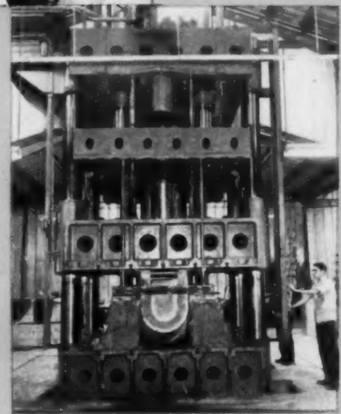
Plastics tooling had by far the biggest year in its history (MPL, Sept. '54, p.85). Stimulated by the success of test installations, many of the major automobile and airplane manufacturers began to give serious consideration to the economies inherent in plastics tooling. Forming dies, jigs, and fixtures that were fabricated of reinforced plastics in 1954 ran into the thousands and covered a wide range: a 4 ft. long die was made for stamping out steel parts for the automotive industry and a draw die measuring 14 ft. long was designed for use by the aircraft industry.

As industrial personnel became more familiar with the advantages of plastics pressure-sensitive tapes, this application also grew by leaps and bounds in 1954. Prime emphasis was placed by tape manufacturers on tailoring each of the hundreds of tapes available to a specific phase of the complex requirements of industry. As a result, plastics protective pipe wrap, marking, electrical insulation, and magnetic recording tapes really came into their own during the year. Much of the experimental work of 1954 was concerned with adapting the versatile polyester films and polytetrafluoroethylene films as tape backings.

...in industrial use

Courtesy Minnesota Mining & Mfg. Co.

Easy-to-apply and corrosion - resistant, protective pipe wrap was one of 1954's fastest growing markets for vinyl pressure-sensitive tapes



Epoxy-fibrous glass draw die, measuring 14 ft. long and weighing less than 1/3 as much as a comparable metal tool, was designed, built, and assembled for aircraft company by Tru-Scale, Inc., in a period of 60 days

Courtesy Beech Aircraft Corp.

...in photography

NEW DESIGN THINKING, AIMED AT MAKING single large plastics moldings replace intricate assemblies of small plastics or metallic parts, extended the use of plastics materials into the more specialized phases of the photography field. Leading the list of successful applications of this new emphasis in 1954 were a streamlined photo enlarger (MPL, July '54, p.90), a stereo camera, and a stereo viewer (MPL, Oct. '54, p.97).

In addition to the obvious economies effected in production through the use of plastics, all three pieces of equipment were distinguished by the sound judgment displayed by the manufacturers in selecting proper plastics materials to meet specific end-use requirements. The high heat resistance of phenolic and the ease of moldability of styrene, for example, played leading roles in the success of the all-plastics photo enlarger. And the stereo camera and stereo viewer, both designed exclusively for plastics, effectively put the specialized properties of phenolic, nylon, acrylic, and butyrate to work.

All three units also exemplified the trend towards design based on large "complicated" plastics parts incorporating molded-in operational features and all the lugs, cored bosses, slots, and openings necessary for speedy, effective assembly.

Courtesy Eastman Kodak Co.

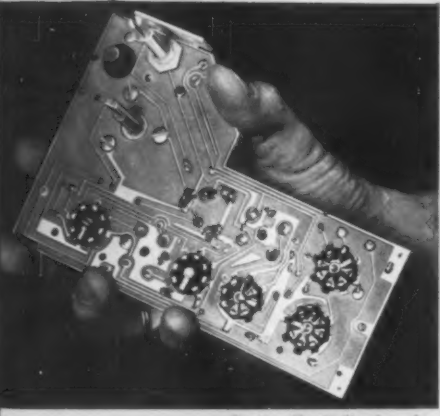
Design of stereo camera, using molded phenolic, acrylic, nylon, and butyrate parts, takes full advantage of plastics' versatility

Courtesy The FR Corp.

Each of the three basic components of all-plastics photo enlarger is molded in one piece, complete with all the lugs, grilles, and openings essential to speedy and economical assembly

...in electronics

Courtesy Shell Chemical Corp.
Motor stator winding which doubles as a pump housing is made pressure-tight by being potted in epoxy resin (right)



Phenolic-copper laminate panel serves as base for printed circuit used in lightweight, compact radio
Courtesy The Hallicrafters Co.

DEVELOPMENTS IN THE FIELDS OF INDUSTRIAL automation and miniaturization in 1954 owed much to the year's significant advances in the use of plastics for printed circuitry and potting.

Production automation, for example, moved into industry at an accelerated pace in 1954, thanks largely to increasing knowledge of the application of printed circuitry to the design of electronic computers, industrial control units, servo mechanisms, and similar equipment (MPL, Apr. '54, p.91). As improved laminates, especially the epoxy-fibrous glass materials, were introduced to the market, the science of printed circuitry also continued to have a marked effect on the size, design, and cost of such commercial products as radios and television sets. It is estimated that production of printed circuits in 1954 more than tripled that of 1953.

At the same time, both printed circuitry and potting were used to advantage in 1954 to meet the demanding requirements of miniaturization.

Industry, in addition, became increasingly aware of the improved physical, chemical, and electrical properties to be derived by potting electronic and electrical mechanisms. In one of 1954's outstanding examples, potting a motor stator for a refrigeration compressor pump not only helped to reduced the size of the pump by 27%, but made the stator pressure-tight, mechanically stable, and fully resistant to Freon at 350 p.s.i., at temperatures ranging from −20° F. to 250° F.

...in signs and displays

Courtesy Einson-Freeman Co.
Three-dimensional counter display of a manufacturer's trademark is preprinted in distortion, then vacuum formed so that colors register accurately in position

One half of huge formed acrylic sign, which will have an over-all diameter of 13 ft., is hoisted into position on roadside billboard
Courtesy Rohm & Haas Co.

TAKING OVER FROM METAL, WOOD, AND paper at the point where cost or design requirements place severe limitations on the use of these materials, plastics received credit for the success of a major share of the outstanding signs and displays created in 1954.

Improved fabricating techniques made it possible to form larger thermoplastics sheets . . . and the signs of 1954 were consequently bigger, more colorful, and more dramatic than those of recent years. Emphasizing this trend was the introduction in 1954 of a sign fabricated of acrylic for Shell Oil Co., reported to be one of the largest illuminated acrylic signs ever made for outdoor use (MPL, Feb. '54, p.112). Produced in two parts, the sign has an over-all diameter of 13 feet.

Huge outdoor displays molded of reinforced plastics also hit a new high in 1954 with the appearance of a "giant spectacular" motor truck 13 ft. wide from fender to fender and standing 18 ft. high (MPL, Sept. '54, p.107).

Sign designers also expressed keen interest in the adaptability of vacuum forming to the creation of three-dimensional store window or counter signs and Christmas displays (MPL, May '54, p.87). Special attention was focused on new methods of preprinting flat sheets in distortion and then forming so that the colors register in position. Introduction in 1954 of a butyrate sheet especially formulated for outdoor use and improvements in techniques for metallizing thermoplastics sheets further added to the future potential for vacuum formed signs (MPL, Sept. '54, p.117).

...in "do-it-yourself"

SALES VOLUME OF ALL PRODUCTS AIMED AT the "do-it-yourself" market continued to grow rapidly in 1954; special efforts were made on the part of the plastics industry to cultivate this fabulous new and virtually inexhaustible field (MPL, Aug. '54, p. 87).

Introduction through retail outlets of plastics home decoration materials, previously limited almost entirely to professional type installations, was the major trend in the year's activities. Self-applied decorative laminate surfacings and vinyl wall and floor tile, in particular, appeared on retail shelves in increasing quantities.

To add to the basic consumer appeal of these materials, emphasis was on colorful new patterns and on simplified installation. Outstanding was an attractive new adhesive-backed vinyl floor tile protected on the adhesive side by a thin polyethylene film. Installation is easy and economical; the film is stripped off and the tile is pressed into place by hand.

Even more dramatic in the "do-it-yourself" field was the introduction of underground lawn sprinkler kits, made possible by taking advantage of the properties of extruded flexible butyrate and polyethylene pipes (MPL, Aug. '54, p. 87).

Kit for installing sprinkler system includes 80 ft. of polyethylene pipe

Courtesy Bakelite Co.

Adhesive-backed vinyl tile designed by Robbins Floor Products makes a relatively simple job of laying a new floor

Courtesy U. S. Rubber Co.

...in toys

NEARLY HALF OF THE TOYS THAT WERE SOLD over store counters in 1954 to the tune of a record $1 billion were either made entirely of plastics or incorporated plastics parts as major components.

Emphasis on realistic toys in 1954 was built to a large extent around the design potential of plastics materials in large-volume applications (MPL, Nov. '54, p. 89). Similarly, the basic requirement of the toy industry for playthings that are durable and safe to play with was more than met by adapting the flexible plastics —especially polyethylene and vinyls—and the newer high-impact rigid plastics to the design of attractive "unbreakable" toys (MPL, June '54, p. 148). Attention also focused on the successful introduction of washable teddy bears stuffed with shredded polyurethane foam (MPL, Nov. '54, p. 108). Foam stuffing is expected to have a radical effect on the manufacture of all stuffed toys within the next two years.

Capitalizing on the improved plastics materials and techniques, additional advances were made by the toy industry in 1954 in extending the use of plastics into the larger, more expensive type of toys. Leading the parade were a number of model toy car bodies fabricated of polyester-fibrous glass laminate or formed in one piece of rigid vinyl sheet (MPL, June '54, p. 148 and Nov. '54, p. 203).

Bag for children's toy medical instruments is molded of polyethylene to look like real doctor's kit

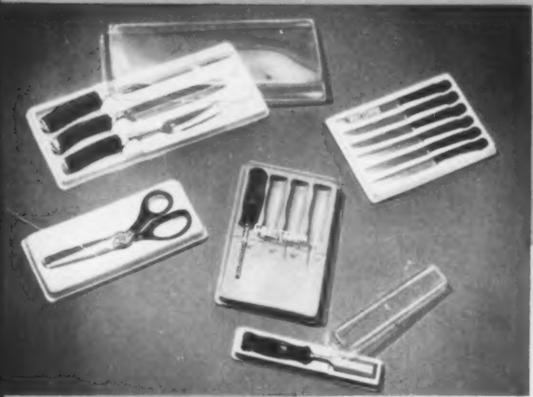
Courtesy Bakelite Co.

Swing toward larger plastics toys culminated in '54 with introduction of vinyl body for miniature car

Courtesy Seiberling Rubber Co.

Courtesy Rohm & Haas Co.

...in packaging



Courtesy U. S. Rubber Co.

Display packages are conveniently vacuum formed of styrene copolymer sheet to the exact contours of hardware items

Functional advantages of new polyethylene tubes include specially designed head to control drop-by-drop dispensing action

Courtesy Bradley Container Corp.

Two significant application trends that gained momentum in 1954 added still more to the importance of plastics in the future of the packaging field. Each involved the use of a new production process—one, vacuum forming; the other, a special extrusion-fabrication technique designed for the manufacture of polyethylene squeeze-to-use bottles and tubes.

As a versatile process particularly applicable to the production of transparent or opaque containers that fit the gap between low-cost film wrap or bags and expensive molded containers, vacuum forming captured a large share of the packaging industry's attention (MPL, May '54, p. 87). Most interest centered on the sales potential of packages formed to the contours of the packaged items and designed to be used as convenient storage receptacles for the items after purchase. Also under consideration was a method of encasing a carded item in a transparent thermoplastic skin by vacuum forming in a single operation.

The second development was the adaptation of an extrusion-fabrication technique to the manufacture of a line of new, low-cost, functional polyethylene containers that included what was claimed to be the first collapsible polyethylene tube in broad commercial production in this country (MPL, Dec. '54, p. 94). A new high-quality printing method and an electronic sterilization process developed in conjunction with the containers also attracted attention.

...in automobiles

Courtesy General Motors Corp.

Specialized mass-production equipment and methods developed in 1954 contributed to success of sleek Corvette reinforced plastics body

Attractive seat side panels formed of styrene copolymer sheet improve appearance of car interior and lower maintenance costs

Courtesy U. S. Rubber Co.

True to predictions, the amount of plastics used in 1954 automobiles reached a record high. Following up on the notable advances of 1953 (MPL, Feb. '53, p.75), the most dramatic of these gains was made in the adoption of reinforced plastics for car bodies. From a production standpoint, the highlight of the year was the design and construction of a complete plant intended expressly for the high-speed manufacture of body parts (MPL, Aug. '54, p.115). Using steel production dies and specialized preforming, compression molding, finishing, and assembly methods, all activities at the plant were directed towards the economical production of the 84 parts which comprise the body of the first high-production reinforced plastics sports car to be made in the U. S.—the Chevrolet Corvette.

In the field of interior beauty and utility, a dominant trend in 1954 was the growing use of styrene copolymer sheets that can be formed into automotive parts of any desired shape and which have a wide range of colors and finishes. It is expected that the majority of 1955 cars will use one or more such formed parts, either as seat side panels, dash board panels, arm rests, or door linings. Vinyl for automotive interior use also gained prestige in 1954 (MPL, June '54, p.138) and the possibilities inherent in laminating metallized polyester film to fabric and using it as an upholstery material attracted considerable attention (MPL, Sept. '54, p.117).

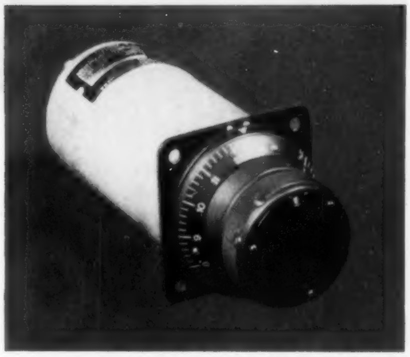
High-Flying Phenolic

Aerial cameras for high altitude photography are accurately controlled by timer incorporating precision molded phenolic parts

THREE tiny internal components, molded of phenolic to dimensional tolerances as close as ±0.001 in., play an important role in the efficient operation of a precision regulating device designed for use on aerial cameras.

Known as the Intervalometer and made by Abrams Instrument Corp., Lansing, Mich., the device is a sequence timing unit for cameras that can function accurately from a varying voltage supply and within the wide humidity and temperature ranges encountered in high altitude aerial reconnaissance photography. Incorporating a small electric motor, the Intervalometer is designed to make and break electrical contacts on a pre-set, precise schedule.

Three molded phenolic components contribute to efficient operation of the Intervalometer (see inset) . . .



. . . a high-precision instrument used for sequence timing of cameras in high-altitude aerial photography

Courtesy Durez Plastics & Chemicals, Inc.

Precision Molding

Since the Intervalometer must work with split-second accuracy, even when photographs are being taken from swiftly-moving aircraft at altitudes as high as 20,000 ft., its operation makes exacting demands on the materials used in its construction.

In molding the three internal phenolic parts, for example, particular care was required to maintain the very close tolerances necessary for accuracy, while keeping within the critical size limitations imposed by the design of the unit. Because of the small amount of space inside the tubular housing of the Intervalometer—the entire unit measures approximately 2 in. in diameter and about 9 in. in length—the three plastics parts had to be quite small in size, which also required relatively thin wall sections.

By choosing an impact-type phenolic compound as the molding material, the molders took advantage of the ease of moldability and the mechanical strength of phenolic to insure proper mold fill and sufficient strength in the parts—despite the thin wall sections—to withstand stresses of assembly and use.

At the same time, careful attention was paid to production control and precision die work during the molding operations. The parts are produced in a family mold on a 250-ton compression press. The impact type phenolic is preformed and preheated prior to molding. No shrink fixtures are required to maintain the flatness in the molded parts.

Assembly

Molding the parts of phenolic also facilitates the job of assembly. Fastening metal contacts to one of the parts, in particular, had presented an especially difficult problem. Originally, this part had been tapped in several locations after molding—but the tapping operation was difficult to control to obtain the required fit and the tapped holes were often stripped during successive assembly and disassembly operations in the manufacturer's plant.

These openings are now simply cored in the mold and self-tapping screws are used to assemble the set of contacts to the part. One remaining hole on the side of the part is still tapped to accommodate a set screw. According to the molder, in contrast to the material previously used, the mechanical strength of phenolic permits self-tapping screws to be used and has eliminated the stripping of threads during assembly.

In the operation of the completed Intervalometer, the outstanding electrical properties of phenolic also combine with the strength of the precision molded parts to contribute much to the working efficiency of this important aerial camera mechanism.

CREDITS: Plastics components molded by P. R. Mallory Plastics, Inc., Chicago, Ill., using No. 1544 impact-type phenolic supplied by Durez Plastics & Chemicals, Inc.

Fully assembled from kit of cellulose acetate parts, Twenty Mule Team model is exact in scale and fully authentic

PREMIUMS FOR THE NEW SALES ERA

Only plastics could be used to create authentic models and replicas in kit form for the do-it-yourself market in the premium field

PLASTICS have been recognized for many years as ideal materials for premiums of many kinds. From the urea "Skippy" bowl and the "Little Orphan Annie" mug to the "Captain Video" type of premium, use of plastics in the field is constantly increasing.

In recent years the trend in plastics premium design and manufacture has been largely toward expendable toys and gimmicks of strictly juvenile and temporary interest. Now a new approach to premium evaluation, design, and construction is rapidly upgrading the plastics premium business and is creating vast new fields of application.

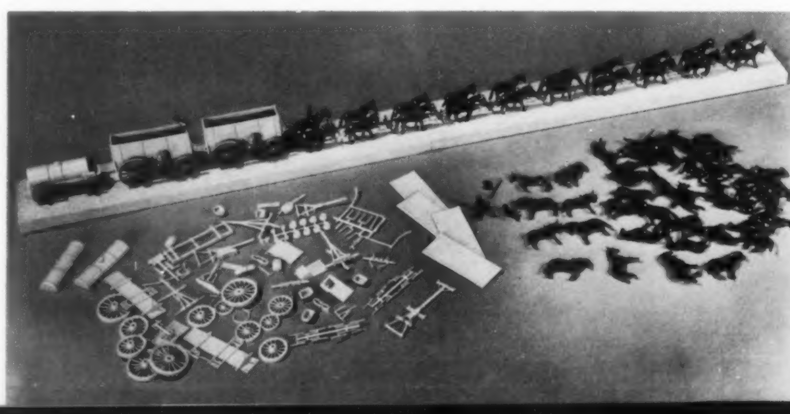
In general, too, premiums are self-liquidating, being made available to the consumer at a price which represents exceptionally good cash value. And the reason that most former plastics premiums have been simple moldings is that the hand labor involved in the assembly of multiple parts and packaging of large assemblies has prevented better and more complicated products from being used as premiums.

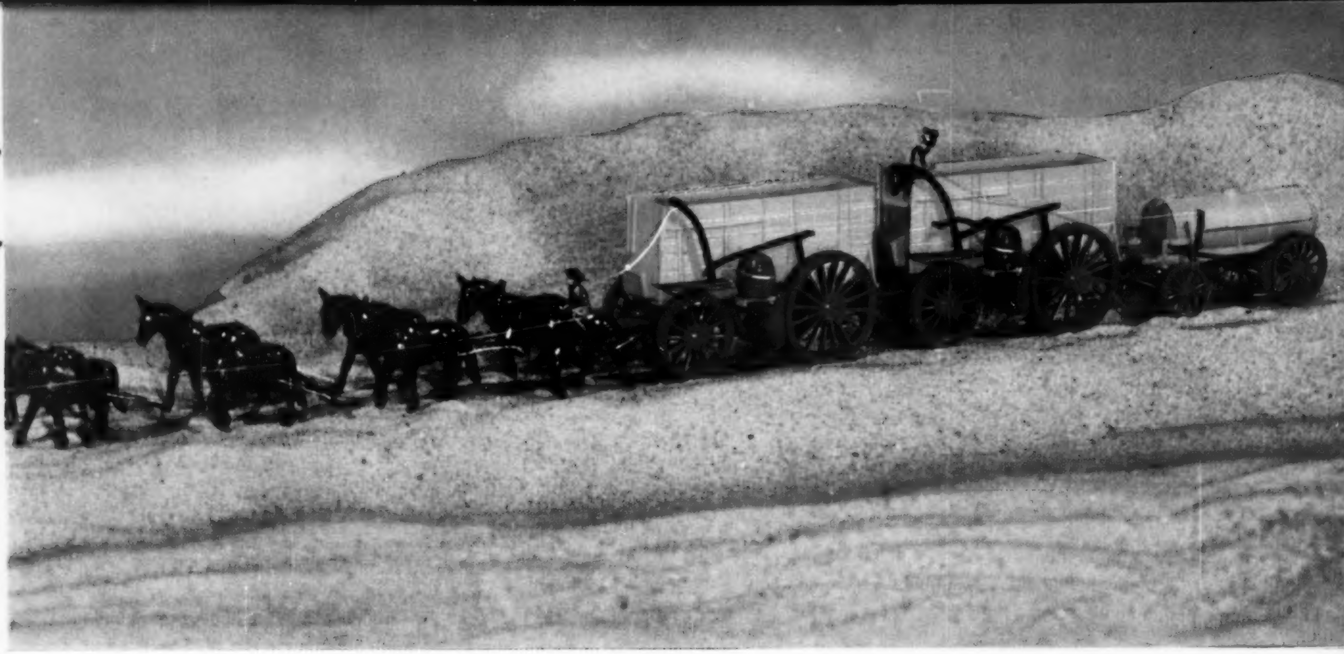
Points for Premiums

With the coming of television, and now with color television, it is important to a premium advertiser that its premium be one that can be easily shown and "sold" on television, one that is readily identified with his product, one that is light in weight and can be shipped at a minimum of expense and of breakage, one that will have "family" appreciation, and one that will build permanent good will for the firm.

With the development of do-it-yourself plastics model kits by Revell, Inc., and the discovery by survey that these kits were well on the way to develop into a national hobby, it became possible for pre-

Components of the Twenty Mule Team Borax premium kit spread out in front of a completed model mounted on board. Mule halves are at right, other components at left





in detail, even to coloration and to the clothing of the mule skinner and swamper. Completed model is 41½ in. long.

miums to be created which would fulfill all of the above-mentioned requirements. Two spectacular cases are reported here: the "Twenty Mule Team" model used as a premium by Pacific Coast Borax Co., Div. of Borax Consolidated Ltd.; and the "Collector's Editions" of exact full-scale replicas of antique guns featured by Kellogg Co. for its promotion of Sugar Smacks and Sugar Corn Pops.

In the first case, the century-old Pacific Coast Borax Co. found it possible to use its own trademark and the romantic history back of that trademark to produce a fabulously successful premium. The history of the twenty mule teams which, up until 1908, hauled borax some 162 miles across mountains and desert from Furnace Creek in Death Valley, Calif., to Mojové is in general well known to almost every American. The driver or "mule skinner" and his versatile assistant, the "swamper," made each one-way trip in ten days in temperatures ranging from 136 to 150° F. under flaming sun, that the world might be cleaner by means of the material they hauled.

Authenticity

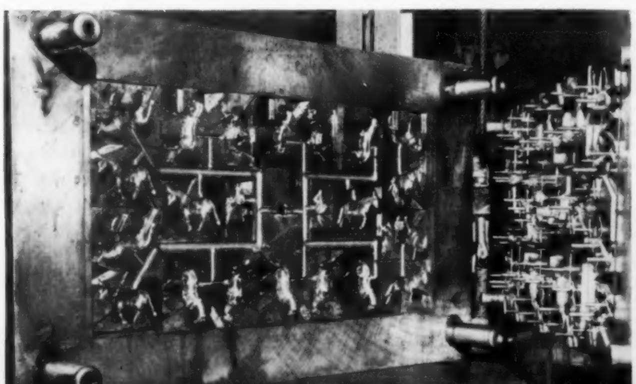
The Borax premium is simply an authentic scale-model of the company's trademark in kit form. Assembly with cement is easy for teenagers or adults; no special skill or tools are required. When the model is completed it has all the detail and authenticity of a handcrafted piece that, made of any other material, would cost literally hundreds of dollars because of the skilled craftsmanship that would be required. The replicas of the 20 mules, the two 25-ton borax wagons, and the 1200-gal. trailer tank wagon make up into a model 41½ in. long.

The whole job is molded of cellulose acetate, the wagon being the same color of pale, light-reflecting blue as on the original borax wagons, and the mules being a very dark brown. Detail in the models is so minute and exact that even the attire of the "skinner" and "swamper" is authentic; water kegs and other small details are equally complete, right down to rivets and the wood grain pattern on the wagons.

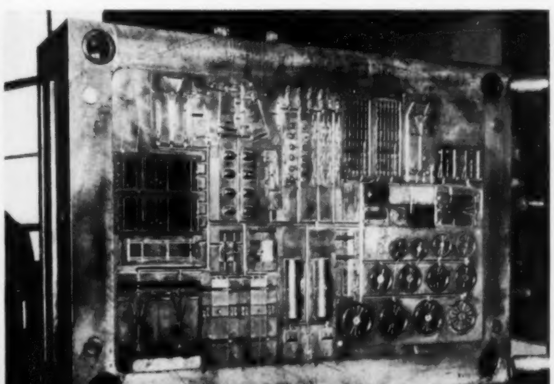
The mule team model is produced in two molds: a 25-cavity mold for the mules and figures, and a 104-cavity mold for the parts of the two wagons and tank trailer.

The drama behind this premium, its beauty, and its challenge to the creative urge now becoming more and more apparent in all people in these days of automation, have given

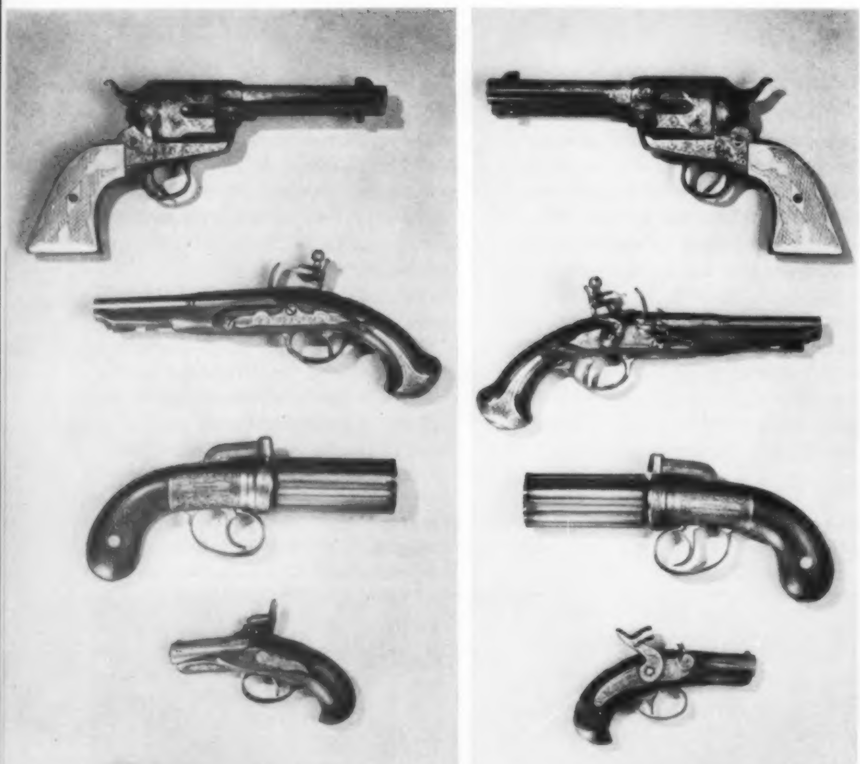
Halves of mules and two complete human figures are produced in 22-cavity mold. Ejector pins are shown in mold part at right, below



A 104-cavity mold produces all the parts for the wagons, the tank trailer, and accessories for the Twenty Mule Team model



Boys from 8 to 80 take great delight in assembling parts of the antique fire-arm replicas. Exploded sketch, furnished with kit, and numbering of parts, makes it easy



Both sides of antique gun plastic replicas made from kits used as premiums by Kellogg show fine details. Top to bottom: Colt, Militia Pistol, Pepper Box, Derringer

it terrific acceptance among both children and adults. It is promoted on the television program "Death Valley Days" by the famous narrator of that program, "The Old Ranger." Supermarket mass displays featuring the kit for $1.00 plus a borax box top are realistically dramatized by the use of an assembled model.

The decision made by the borax company to create the Twenty Mule Team hobby kit premium will one day be recognized as historic. So also will be the plastics engineering involved. It took six months to design and build the molds. It took thousands of man-hours to produce the first unit. Trade and consumer acceptance of the premium offer was all that the borax company had hopefully anticipated. The unanticipated publicity that resulted as the premium became better known was a plus feature that, in itself, more than made the promotion worthwhile.

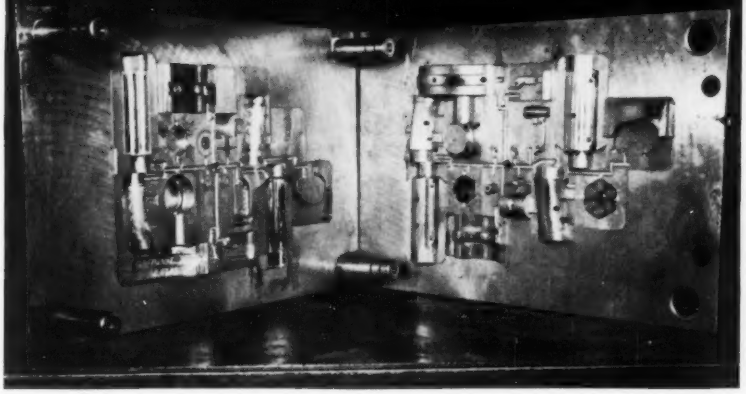
And back of all this is another story — the story of painstaking attention to detail by the plastics molder, of design ingenuity, of the type of intellectual drudgery that so often pays off in accomplishment attainable in no other way.

Authenticity was a must from the very beginning. Revell sent a number of its design staff into Death Valley where the borax company still maintains the last of the actual wagon trains used a half century ago. Hundreds of photographs were taken of every detail of the wagons, the mule harnesses, all the gear employed, even of a mule skinner and swamper in authentic costumes. Measurements were taken of all mechanical parts, later to be translated, with the aid of the photographs, into working drawings.

Antique Fire-arms

In the case of Kellogg Co., which has made use of many kinds of premiums for many years, three elements were required: a) family interest and participation; b) long life and visibility; c) unique value not otherwise obtainable.

There has been, for some time, a constantly increasing nation-wide interest in ancient fire-arms. When Kellogg decided to use exact replicas of antique guns as a premium offer, Revell applied the same intensive research approach as was used in the Twenty Mule Team project.



Authenticity of reproduction of gun replica kit parts demands complicated molds. Ejector plates separate parts from mold to insure perfect reproduction of engraving

Pepper Box pistol and parts. Detailed "metal" parts are produced in the mold shown in illustration at left

Here again authenticity of the finished model was paramount. Hundreds of man-hours were spent in museums, in gun shops, with collectors, and in libraries, to determine the selection of guns, to find examples in good condition, and to gather background material. Old catalogs and manufacturers' manuals were studied to be sure that details of the gun mechanisms would be accurately reproduced in the molds. Only by refusing to ignore minutia and by insistence on reproducing the finest details of the original antique guns, could the molder of the plastic replicas produce premium kits that would reflect the quality of the sponsor's product.

Result of all this behind-the-scenes work was the selection of the Colt Frontier, the Derringer, the Pepper Box, and the Militia Pistol for model reproduction. None of the replicas of these famous fire-arms have "bang-bang" juvenile cap-gun appeal; but all of them have long remembrance value, decorative value and, indeed, treasure value.

Kellogg has used the backs of approximately 12,500,000 packages of cereal to exploit, in full color, this new premium concept. So universal is the interest in the gun replicas that they are plugged on Kellogg's Superman show, on the Wild Bill Hickock show, on the Art Linkletter show, and on the Super Circus show with network coverage. And 25,000 of the largest food outlets in the country are using three-dimensional displays to attract attention to the offer. Each Kellogg salesman is supplied with a display case which, when opened, reveals on one side of the case the various parts that went into the making of the gun, and on the other side a completely assembled weapon.

Actual Guns Used

The hobs for the gun molds were produced by duplicating parts of the actual guns, and the hobs were then hand engraved with the same tools and techniques used by old-time gun engravers to achieve the feel and character of the original.

General-purpose styrene, dry colored, is used for molding the parts of all four guns. Replicas of the Colt metal parts are produced in a 19-cavity mold, the handles in an 8-cavity mold. The mold for the Derringer "metal" parts has 13 cavities. The Pepper Box "metal" parts come from a 16-cavity mold and the Militia Pistol "metal" parts from a 22-cavity mold. The Derringer handles are combined with Pepper Box handles in a 4-cavity mold; the walnut-colored Militia Pistol handles are produced in a 2-cavity mold. Where engraving appears on the sidewalls of cavities, as it does in nearly all the "metal" parts, ejector plates separate the parts from the engraving without damage.

The model guns are available for 50c each, plus a box top from Sugar Smacks or Sugar Corn Pops.

The Kellogg antique gun offer has not yet been before the public long enough for sales increase results to have been collated but its success was almost a foregone conclusion.

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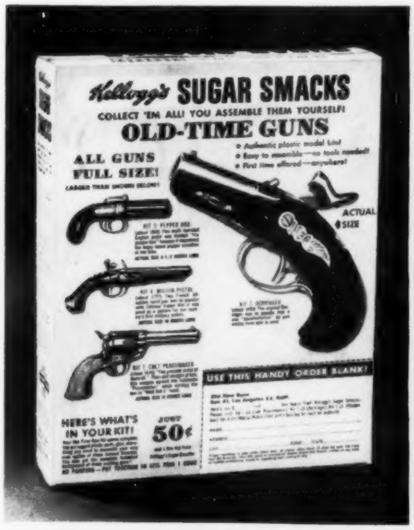
Material supplier, mold maker, and equipment credits for this article appear on page 161.

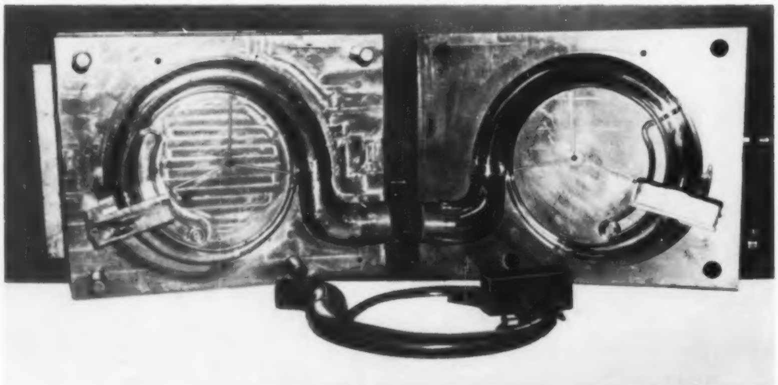


To promote the antique gun replica kit premiums, Kellogg uses both sides of cereal boxes; in addition, the proposition is given fabulous multi-station television advertising

Toy Instruments

Courtesy Emenee Industries, Inc.

Metallized plastic toy tuba (left), injection molded of high-impact styrene, is closely patterned and scaled after full-size band instrument (right)



Male and female parts of mold for half of tuba body (above); other half is formed in similar mold; both halves are cemented together to form the complete body

Mold for bell of tuba; two angular core pulls in center of male half (right) form bayonet lock for attaching bell to elbow of tuba body

More and more toy manufacturers are learning that plastics can be profitably used, when design and engineering are upgraded, to produce high-quality products that will sell—and sell well—in the higher retail price brackets. This was exactly the thinking that led to the development of a line of seven high-grade, all-plastic toy musical instruments that closely resemble the full size instruments after which they were patterned.

Combined in these instruments are realism of appearance, good tonal quality, and ample physical strength to withstand normal abuse by children. These counterparts of modern band instruments can be easily played by the youngsters and are designed not only to amuse their youthful owners, but also to provide basic musical training.

The basic idea for a series of high-quality toy musical instruments was conceived about four years ago when Herbert Merin, a former band leader, and William Kreizel, a chemical engineer by profession, started to pool their thoughts. The result was the formation of Emenee Industries, Inc., with a plant at Flushing, New York, where styrene molding material is being used presently at the rate of ½ million lb. a year to turn out a group of products widely accepted by the trade and the public.

The toy musical instruments in the line are a ukulele—the first instrument produced—trumpet, saxophone, clarinet, trombone, and the recently introduced Golden Glockenspiel and Golden Tuba. All of the instruments are being molded of high-impact styrene, with the exception of the ukulele, which is molded of regular styrene. Retail prices range from $4.00 for the trumpet and clarinet to $15.00 for the tuba.

Largest and most outstanding toy instrument in the group is the Golden Tuba. It is an authentic reproduction of a standard tuba, with modifications to meet the requirements of good molding practices. The Golden Tuba stands 3 ft. high and has a musical range of one octave.

In choosing styrene for the toy

Make Real Music

High-quality molded styrene products, well designed and well engineered, are patterned after full-size modern band instruments

Four-color plates courtesy Catalin Corp. of America

Other instruments in line of musical toys include trumpet, clarinet, saxophone, ukulele, trombone, and glockenspiel shown in color illustration on p. 115; all instruments are being pitched to the same key, making harmonious group playing possible

Courtesy Emenee Industries, Inc.

musical instruments, the manufacturer was influenced by the light weight of the material, its durability in adequate wall sections, and its low cost.

The striking resemblance of the toys to full-size instruments, coupled with good design, precision molding, well planned assembly operations, and an intelligent job of sales promotion and merchandising provided a combination that assured success almost from the start.

Mass Production

Economics of the toy industry demand the use of mass production techniques. In order to achieve maximum production and hold assembly costs to a minimum, Emenee employs the continuous assembly line procedure for each individual musical toy.

Emenee's first venture in the toy musical instrument field was the ukulele, which was injection molded of styrene. This proved to be an immediate success and convinced the company that a definite market exists for musical toys with which a child can actually play tunes. On the basis of this initial success, Emenee produced the Golden Trumpet, an instrument that had been under development for two years.

Molded of high-impact styrene, the 14-in. trumpet, with wall sections of 0.080 to 0.100 in., produces its notes through four hand-tuned brass reeds which can be played individually or as chords.

The ready acceptance of the Golden Trumpet by the jobber, retailer, and consumer prompted Emenee to extend its line and produce, in rapid succession, the Golden Slide Trombone, the Ebony and Silver Clarinet, and the Silver Saxophone.

Again, each toy was a scaled counterpart of the full-size instrument. The clarinet and saxophone will produce a complete octave with two additional harmonizing major chords.

The Golden Glockenspiel, introduced in 1954 along with the Golden Tuba, is over 25 in. long and can be played as either a glockenspiel or as a xylophone. The eight precision-tuned aluminum bars, which will sound a complete octave, are mounted in a holding frame molded of styrene.

Assembly Techniques

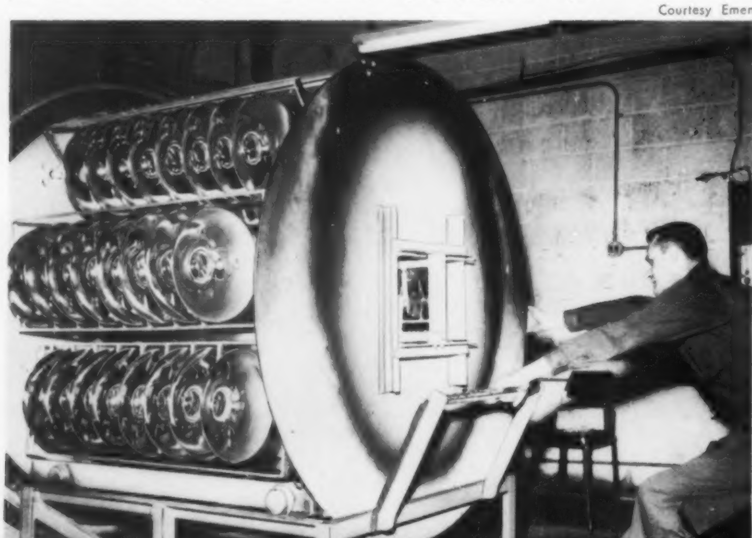
Most impressive molding and assembly job in this entire group of toy musical instruments is the production of the tuba, parts for which are produced in five different molds. Molding is done on 12-oz. injection machines and production rate with each mold is approximately 90 shots an hour. Molds were precision-machined from Cascade steel, a precipitation-hardened low-carbon aluminum-nickel tool steel.

The body of the tuba is produced in two halves, individual molds being used for each, with the music-holder included in the right-hand half. A two-cavity mold turns out the two halves of the elbow and the bell is molded complete in a single-cavity mold provided with two angular core pulls to form a bayonet lock. Raised letters and scroll designs are molded into the outer surface of the bell.

The smaller parts of the tuba, including the two sides of the sound box, the keys and plungers, the pieces for the mouthpiece extension and mouthpiece, etc., are all produced in a combination mold. All

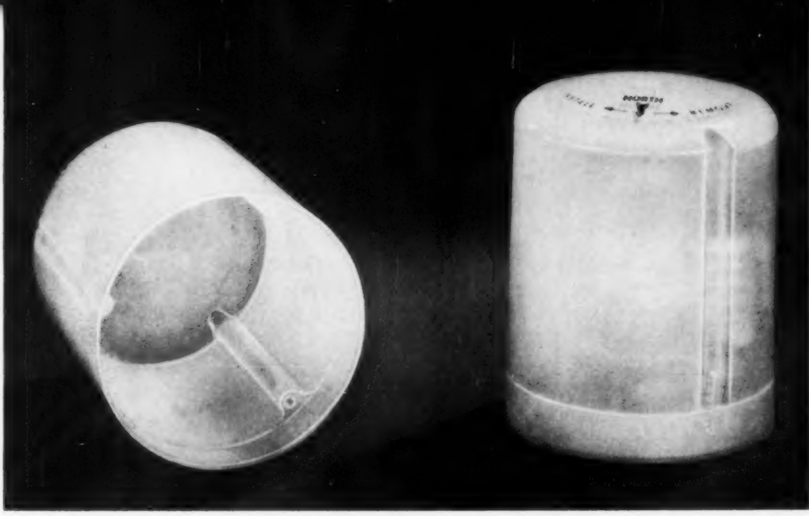
(*To page* 198)

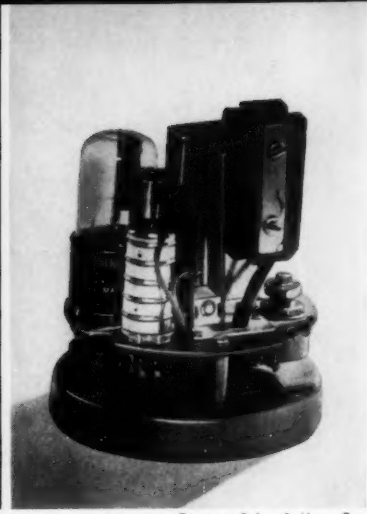
Rack is removed from vacuum metallizing chamber after vaporized aluminum has been deposited on tuba bells; "gold" finish is achieved by applying yellow dye to the aluminum



Assembled toy tubas, having been thoroughly inspected, are packaged in handy carrying cases

Courtesy Emenee Industries, Inc.





Courtesy Rohm & Haas Co.

As light is transmitted through protective acrylic cover (center), light-sensitive switch (right) turns street light on or shuts it off, according to variation in light values. Cover is attached to base by screws running through bosses molded into the cover (left)

Darkness Lights the Lamps

Acrylic cover transmits and diffuses rays which actuate light-sensitive switch, protects delicate mechanism

THE light-diffusing and light-transmitting properties of heat- and weather-resistant acrylic play an important role in the efficient operation of a compact light-sensitive switch for individual control of street lights and other outdoor lamps.

The acrylic is used in the form of a molded diffusing cover that slips on over the switch after the latter has been mounted. When surrounding light value drops to ½ foot-candle, a light-sensitive electronic tube sets off a train of events that causes the lamp to be turned on. Conversely, when the light value rises, the simple electronic circuit is automatically opened, shutting off the lamp.

The switch is so designed that both trains of events are unaffected by ambient temperature changes in the 0 to 100° F. range. At the same time, since two full minutes are required for the electronic circuit to be opened or closed, transient light from car headlights or flashlights will not operate the switch.

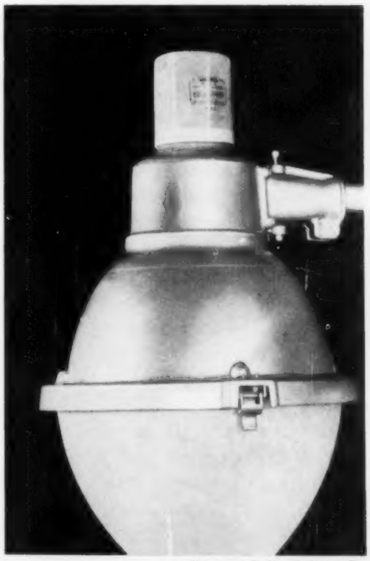
Before deciding upon a molded acrylic cover for the 5 in. high switch, the designing engineers first experimented with an aluminum cover in which a window was cut out to admit light to the electron tube. This construction, however, proved too directional and in some installations exposed the tube to direct sunlight, causing excessive emission and shortening the tube's useful life. Glass covers also proved unsatisfactory because of breakage and the presence of sharp reflectances.

Acrylic is Chosen

The cover which was finally decided upon is molded of clear, heat-resistant acrylic, then sand-blasted on the interior surface to combine the desired degree of diffusion with the high light-transmitting property of the plastic. This treatment enables the light-sensitive tube to sense any light that might fall on the cover from any direction. At the same time, the durable covers, which weigh only 6¾ oz. and can withstand exposure to heat up to 180° F., also function as rugged security shields for the delicate electronic components of the switch.

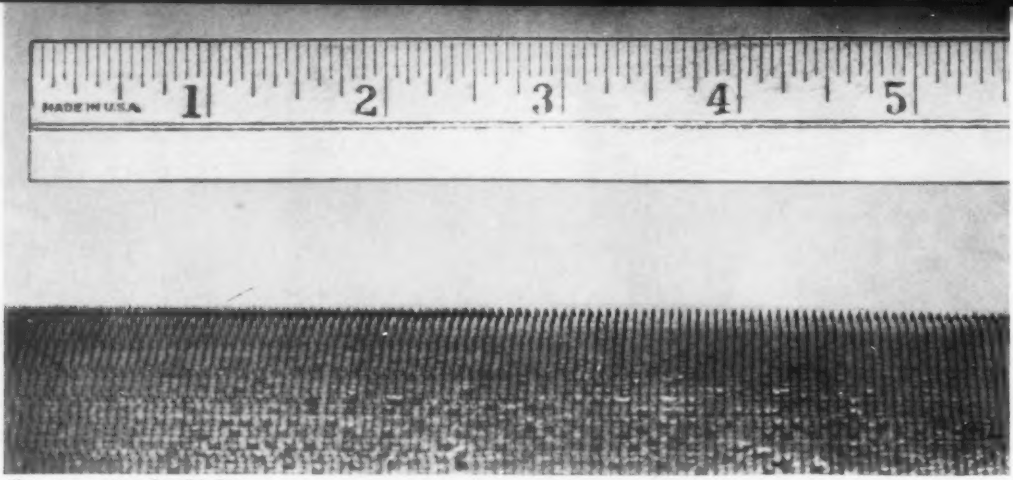
The covers are injection molded on a 12-oz. press, using a 50- to 60-sec. cycle. After molding, the covers are annealed for 4 hr. at 180 to 190° F., then cooled slowly in the ovens. Three threaded bosses molded on the inside of the cover accept Phillips-head screws which attach the cover to the metal base. The acrylic part is designed so that it completely overlaps the base, thereby completely shielding the switch mechanism from exposure to inclement weather.

CREDITS: Covers are molded by Brilhart Plastics Corp., Mineola, L. I.; Plexiglas V-100 heat-resistant acrylic molding powder is supplied by Rohm & Haas Co., Philadelphia, Pa.



Courtesy Rohm & Haas Co.

Compact, lightweight unit is easily mounted on outdoor street lights



Illustrations courtesy Graydick Corp.

Close-up of cylinder used for perforating film and sheet. There are 400 needles per sq. in. of cylinder surface

Porous Plastics Film and Sheet

New mechanical method of piercing tiny holes — as many as 400 to the square inch — in film and sheet opens vast new markets in the upholstery, clothing, packaging, wall covering, and other industries

DESPITE all the inherent desirable properties of vinyl film and sheet, applications in a number of fields have been limited by one important factor: the material is not porous and, therefore, is impermeable to air. Other fields, of course, have widely accepted the non-porous vinyl for its characteristics of wearing ability, moisture-proofness, and inertness to acids and solvents, and because it can be beautifully decorated and embossed to give the surface appearance of almost any other material.

Porous vinyl film and sheet is desirable for many reasons and, during the past few years, a number of attempts[1] have been made to develop perforating methods which would not affect the other characteristics of the material. Now it appears that the goal has been achieved with the development of the Poromaster mechanical perforating process.

In upholstery, it is well known that the porosity, and hence the "breathing" property of leather and fabrics, contributes largely to comfort. The same applies to clothing. For example, tests on leathers used for upholstery show an air permeability as high as 2.3 cu. ft./min./sq. ft. at a 10-in. pressure drop. Jacket leather, submitted to the same tests, shows a factor of 4.9, and the finest kid glove leather, 6.5.

As in Natural Materials

It has long been the aspiration of manufacturers of plastics film and sheet to produce similar or greater air permeability in their products. The main difficulty was that a very great *number* of pores, similar to those found in natural materials, was necessary. If vinyl could be produced with as many as 400 pores per sq. in., the desired air permeability could be achieved. It is reported that this number of perforations can be made by the Poromaster process and that the hole size can be controlled from as small as 0.005 up to 0.018 in. in diameter. Even at the size of 0.018 in., the pores are so small as to be barely visible and the look or feel of the treated material is claimed to be unaltered.

Porosity of the treated material can be calculated to correspond exactly to that of leather or to have an air permeability many times greater, as is found in textile fabrics. Because of the smallness of the holes, the tensile strength of the sheets is not substantially impaired. Supported film and sheet can be perforated from either side without damaging the fabric in any way.

It is reported that the process is simple and that the equipment can be put in line with existing calendering, embossing, printing, or inspection machines. Speed of operation is completely controllable and it is claimed that the Poromaster can be run even at the high speed of a printing machine. This means that no special unwind or rewind operations are required for perforating film or sheet.

Tests[2] run on many different types and thicknesses of vinyl sheet and film (both supported and unsupported), which have been treated by the Poromaster method, show a porosity which is from 3 to 4 times greater than that of the finest kid glove leather; 4 to 5 times that of jacket leather; and 10 times that of unvarnished upholstery leather. Where water resistance and waterproofness is not a factor, a much

[1] For examples, see "Electric Control of Porosity," Modern Plastics, 97, *28* (Feb. 1951); "New Vinyl Film that 'Breathes'," Modern Plastics, 90, *30* (July 1953); and "Porous Vinyl," Modern Plastics 185, *31* (May 1954).

[2] Specific figures in this report are from tests made by U.S. Testing Co., Inc., Hoboken, N. J.

higher degree of porosity can be obtained with the Poromaster process. In such cases, the air permeability factor can be increased to even 100 times the figures given above.

When vinyl film is to be used as a wall covering, porosity is an important advantage. It allows passage of moisture from the walls, thus preventing mildew formation under the film. In furniture and automotive slip covers, perforated sheet or film prevents condensation of moisture by providing an avenue of escape. Another advantage of air permeability is that sheets or films of plastic can be laminated with adhesives, the solvents of which can evaporate through the porous film.

The Poromaster consists essentially of a metal cylinder with as many as 400 fine needles per sq. in. covering its outer surface. The needles are made of special carbon steel and have unusual tapered ends, as shown in the accompanying drawing. The fine points of the needles perforate the sheet in such a way that no tearing stress is set up in the material and no lateral force is applied which would result in breaking of the points themselves. It is stated that there is no increase of working temperatures of the material at any operating speed.

Perforating Cylinder

The Poromaster perforating cylinder is made up of sections 6 in. wide. Thus, if any accident should occur, the damaged section can be replaced quickly. The cartridges or sections are interchangeable and the size of the pores can be changed at will by using cartridges with needles of different diameters; hole size can also be altered by adjusting the needles themselves. For example, using a needle 0.018 in. in diameter, it is possible to make 0.009 in. or even 0.003 in. holes. This is done by effectively shortening the tapered point of the needle to ½, ¼, or even to ⅛ of the tapered length. It is thus possible to use the Poromaster on sheet as heavy as 0.040 in. or film as light as 0.002 in., without having to change the sections or cartridges, which are mounted and keylocked on one shaft.

In addition to vinyl, the Poromaster process can also be successfully applied, it is reported, to polyethylene (both in sheet and flat tubing), cellophane, cellulose acetate, waxed paper, glassine, and papers (plain as well as laminated) where a controlled amount of air permeability is required.

New and Old Markets

With the availability of plastics film and sheet having the added advantage of air permeability, new markets open up; at the same time, old markets should be stimulated. For example, automobile and railway car manufacturers have not yet gone very far in the use of supported vinyl sheet upholstery because of the lack of air permeability. Also, the sensational success of automobile slip covers woven of extruded plastics filaments is at least partly due to lack of air permeability of supported vinyl sheet.

By processes already in use, upholstery sheeting can be decorated and embossed to simulate the most expensive leathers and fabrics. With porosity now available to them, plastics sheets and films should conquer more of the living room and should enter the bedroom, the nursery, and all other parts of the home. And for vinyl wearing apparel, the new porosity should be a blessing and a boon.

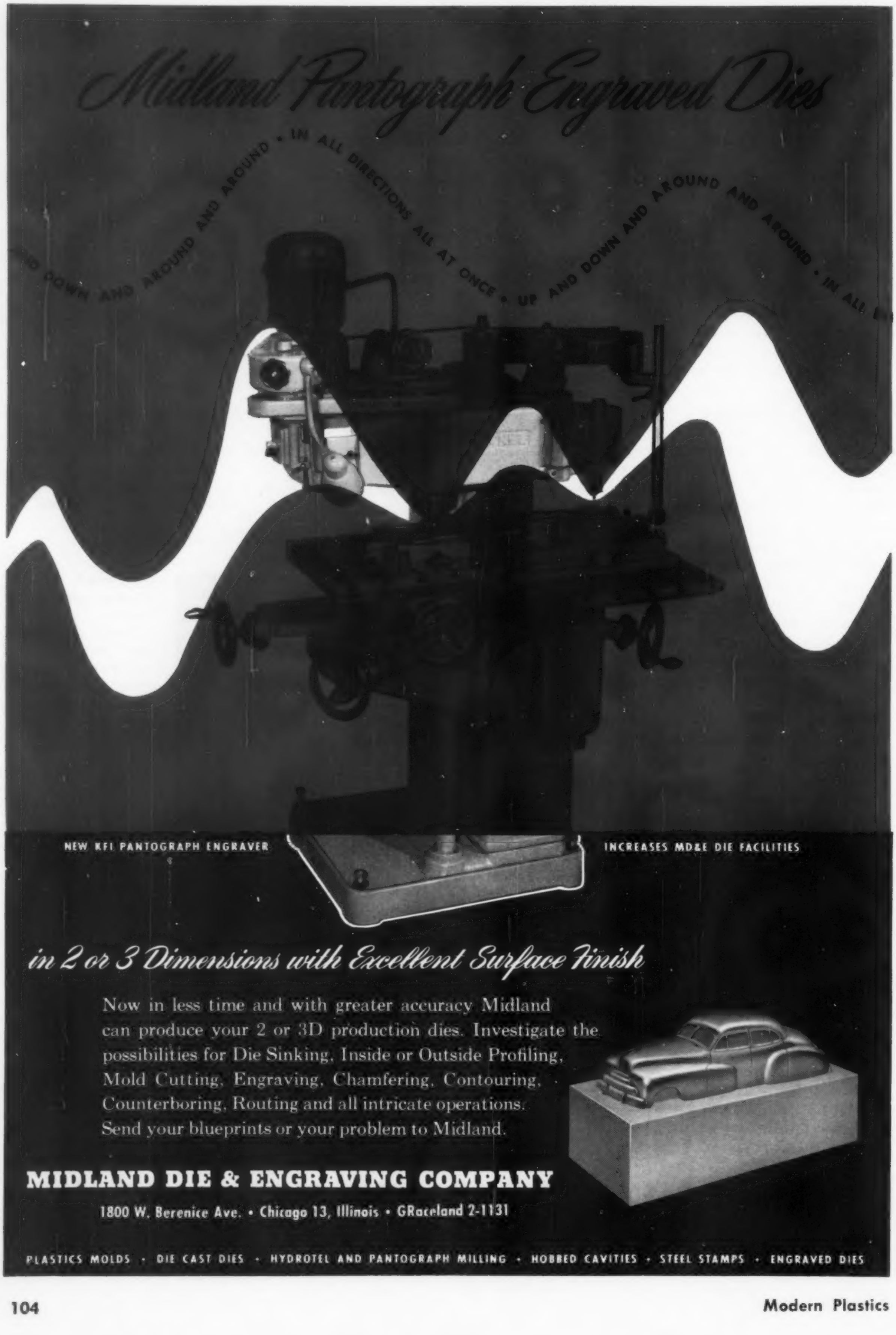
The Poromaster is an invention of Marc A. Chavannes, well known to the vinyl film and sheeting industry. Further details regarding the Poromaster process of attaining air permeability may be obtained from Graydick Corp., 247 Park Ave., New York, N. Y.

Vertical view of perforating cylinder or cartridge, with ruler at right to give scale of size. In use, cylinders are mounted end to end on a single shaft; cylinders can be individually replaced in the event of damage

Left: Greatly enlarged drawing, with actual dimensions indicated, of a needle of the type used for perforating. Note that the taper is perfectly uniform; size of perforation produced can be controlled by change of effective needle length

Below: A group of needles, 0.010 in. in diameter, of the special design developed for use in the perforating cylinders shown on these pages

Below: Group of needles with diameters of 0.018 in., for comparison with group at left below


Midland Pantograph Engraved Dies
DOWN AND AROUND AND AROUND • IN ALL DIRECTIONS ALL AT ONCE • UP AND DOWN AND AROUND AND AROUND • IN ALL
NEW KFI PANTOGRAPH ENGRAVER
INCREASES MD&E DIE FACILITIES
in 2 or 3 Dimensions with Excellent Surface Finish
Now in less time and with greater accuracy Midland can produce your 2 or 3D production dies. Investigate the possibilities for Die Sinking, Inside or Outside Profiling, Mold Cutting, Engraving, Chamfering, Contouring, Counterboring, Routing and all intricate operations. Send your blueprints or your problem to Midland.
MIDLAND DIE & ENGRAVING COMPANY
1800 W. Berenice Ave. • Chicago 13, Illinois • GRaceland 2-1131
PLASTICS MOLDS • DIE CAST DIES • HYDROTEL AND PANTOGRAPH MILLING • HOBBED CAVITIES • STEEL STAMPS • ENGRAVED DIES

Engineering Progress in 1954

DURING 1954, descriptions of 14 new injection machines, many of them fully automatic, were published in the New Machinery and Equipment department of MODERN PLASTICS Magazine.

The details of these machines make it evident that machinery builders are bending every design effort towards increasing the speed, plasticizing capacity, reliability, and general over-all efficiency of their equipment. At least two additional companies entered the field of injection machine manufacture during the year.

Also during 1954, at least seven new vacuum forming machines were announced, all of them far superior to machines built only 1½ years ago. Vastly improved in appearance, their better controls, more efficient heaters, and faster cycling have made it possible for users of the vacuum forming process to greatly increase output quantity and size and, at the same time, turn out products of far higher quality. At least three new companies started production of vacuum forming machines during the year.

The year 1954 saw the first production from a plant specially built for mass production of reinforced plastics automotive bodies in matched metal molds, using equipment specially designed for the purpose.

After evaluating the performance of a reinforced plastics truck body, a large parcel delivery service placed an order during 1954 for 19 additional bodies to further study the material in service.

The greatly increased use of plastics in metal working tools—bolstered by the vast number of inquiries received after publication in September MODERN PLASTICS of the article "Metal Working Swings to Plastic Tools"—indicates that this plastics application will revolutionize many facets of the metal working industry. The recent announcement by two of the leading manufacturers of epoxies of a 10¢/lb. price decrease will give added impetus to this phase of the plastics business.

These are but a few examples of how the plastics industry increased in breadth and efficiency during 1954. Other examples will be found in the articles reviewed herewith and in the articles briefly condensed and listed below, all of which were published in the Engineering Section of MODERN PLASTICS Magazine during 1954.

Flame-Spraying of Polyethylene, by Randolph A. Wiese (February issue), described a research project which the author undertook for the U. S. Atomic Energy Commission. The problem was to line the concrete walls of a decontamination cell at Brookhaven National Laboratory. Since these walls required periodic washing down with nitric acid, and since this acid attacked the concrete,

(*To page* 199)

*Reg. U.S. Pat. Off.

Moldable Reinforced Sheet

Courtesy Minnesota Mining & Mfg. Co.

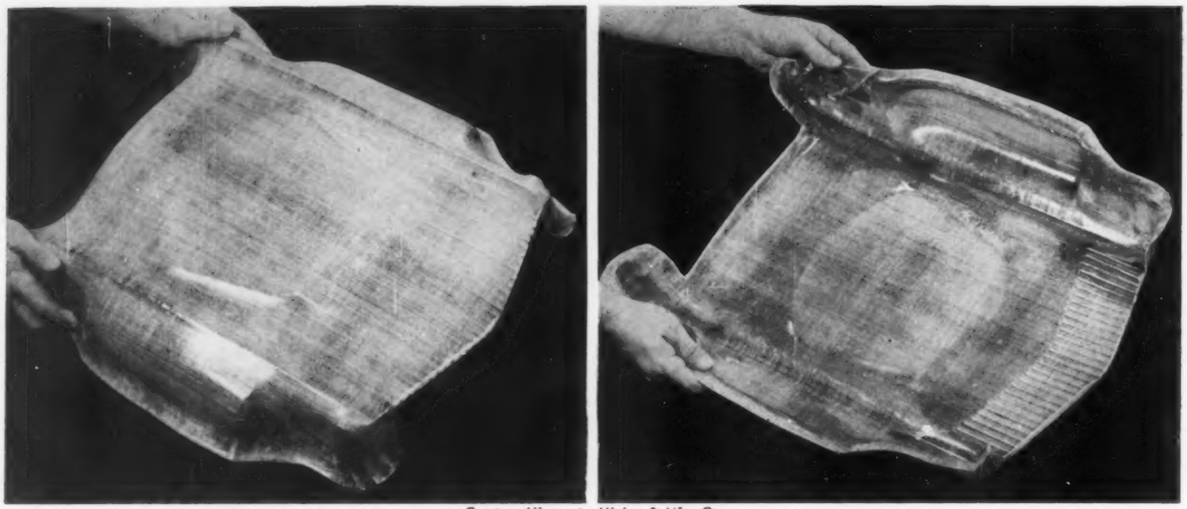
Protective cover is removed from new reinforced sheet prior to molding

A NEW formable reinforced plastics sheet stock, the results of a 10-year development program by the Tape Div., of Minnesota Mining & Mfg. Co., St. Paul, Minn., is now being marketed in initial production quantities under the tradename of Scotchply. This epoxy pre-impregnated material is produced by bonding together individual thin plies of unidirectional glass fiber filaments and orienting the layers of the glass reinforcements.

The outstanding characteristic of these sheets lies in controlled alignment of the reinforcing glass filaments, making it possible to tailor the material to satisfy specific end use requirements.

For example, if the application calls for uniformity of strength in all directions in the laminating plane, an isotropic laminate may be used in which successive layers comprising the sheet are oriented at an angle of 120 degrees. If high strength is demanded in two perpendicular directions, a sheet having a simple 90° cross-lamination is used.

However, in cases where exceptional strength properties are required in one principal direction only, the type of sheet recommended



Courtesy Minnesota Mining & Mfg. Co.

New fibrous-glass reinforced plastics sheet can be molded into intricate shapes with complex draws, as illustrated by top and bottom views (above) of an experimental housing for a rotary lawnmower made of this material for Toro Manufacturing Co.

is one in which all the lineally aligned glass filaments run in the same direction. In all instances, the thickness of the uncured sheet and the resulting laminate depends upon the number of individual layers in the complete "sandwich." Each ply has a gage of approximately 8 mils.

In addition to tailored physical properties, the system of continuous lamination used in preparing the uncured Scotchply material makes it possible to provide built-in color and other surface effects on the outer surface. During the molding and curing operation, these decorative finishes are sealed into the laminate, eliminating the need for subsequent painting or application of decals, transfer sheets, etc.

For color and wood grain effects, the decorative surface is reproduced on a fibrous glass system which is laminated into the sheet in such a manner as to form the top surface. Scotchply may also be supplied with the top surface comprised of a thin copper sheet, for use in printed circuit panels.

Designed for processing into finished form by means of pressure bag molding, vacuum bag molding, or with matched metal or plastic dies, Scotchply reinforced plastic is distributed in flat or roll form, depending upon thickness. Although sheet sizes have not yet been standardized, the 48-in. width may become the basic standard.

Automatic equipment used in making Scotchply permits widths up to 6 ft., with length limited only by practical considerations of shipment and handling; sheets as large as 6 by 40 ft. have been made experimentally. The uncured sheet material is shipped to the fabricator with both sides protected by means of a crepe paper cover sheet which is easily stripped off prior to molding. As received by the molder, the material is relatively rigid, facilitating transportation and handling.

The shelf life of Scotchply based on epoxy resins is approximately one month at 75° F. and four months at 40° F. Upon long aging at higher temperatures, Scotchply reinforced plastic becomes more rigid. To return the sheet to its original flexible state, it may be warmed slightly through exposure to a temperature of approximately 110 to 115° F. This should not be done, however, unless the sheet is to be molded within a short time.

Although experimental Scotchply sheets have been produced as thick as ½ in., the manufacturer believes that the greatest volume of use will be in the ⅛-in. (0.125-in.) thickness. There is a reduction in the gage of the sheet of from 10 to 20% during the molding operation, depending upon the amount of pressure and other variables.

Using Scotchply pre-impregnated sheets, many items may be fabricated using vacuum or pressure bag techniques. For areas of extreme curvature, it is recommended that a male plug be employed in combination with the bag and mold. Curing may be hastened by heating the mold itself.

Although parts can be vacuum bag molded at pressures available with that method, it is recommended that, for producing parts with sharp draw, matched metal molds and pressures above 25 p.s.i. be employed. Polished steel molds having a tin-plated surface are favored.

Prior to molding, the mold is prepared with a suitable epoxy system release agent. With proper applica-

(*To page* 200)

New Concept of Hot-Runner Molding

A NEW approach to the elimination of cold runners, which seems to get around all the problems in hot-runner mold design, has recently been proved-out in actual operation by the Engineering Dept. of Improved Machinery, Inc. For want of a better name it is called Multiple Nozzle or External Hot-Runner molding. The following description of this novel development has been prepared by George W. Whitehead of Impco.

In this method of molding, the die is so designed as to allow a nozzle or an arrangement of nozzles to gate directly into the cavity or cavities. It can be used with one, two, three,

four, or more nozzles, so arranged as to afford good solid contact with the die without leakage. Leverage is important and must be considered for each particular arrangement of nozzles in order to prevent leakage. One, two, or three nozzles present no particular problem; however, four nozzles require use of two groups of two nozzles each.

One nozzle has been used extensively before in external hot-runner molding; however, two or more had not been applied in practice to any extent. Impco, therefore, decided to investigate multiple nozzles.

The advantage of this procedure is that it eliminates runners and sprues, a condition which is highly desirable in automatic molding.

The accompanying cut-away cross section of the nozzle arrangement shows how this method was applied in molding two 12-oz. tumblers. It should be noted that the only contacts of hot metal with the relatively cold mold are the actual tips of the floating nozzles. All other parts — the nozzles, the cross head, the connecting nozzle, and the heating cylinder — are surrounded by air. The cross head is protected against the danger of radiation loss by means of asbestos board disks.

Thus the mold may be cooled to whatever degree desired without affecting the hot-runner arrangement. Independent temperature control of the bottom insert which contacts the nozzle permits regulating the temperature at that point to the required degree.

The basic feature of this mold design centers around the use of an auxiliary heated nozzle on a heated cross-head feeding into a multiplicity of heated nozzles, with the entire arrangement insulated by air from the mold except at the contact points between nozzle and mold.

This arrangement eliminates all insulation problems which to date have presented the biggest drawbacks to more wide-spread use of hot-runner molds.

(MODERN PLASTICS, Sept. 1954.)

What Causes Mold Erosion?

FOR almost as many years as phenolics have been molded, the problem of mold erosion has plagued the plastics industry.

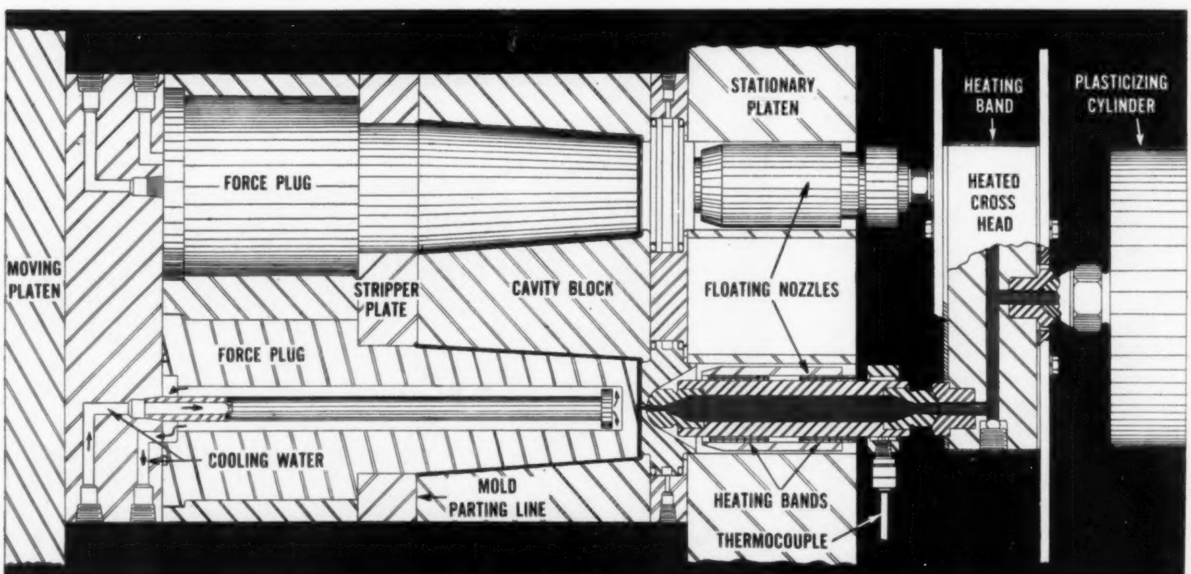
Since metallurgy has not provided the answer, the molder obviously must turn to the molding powder manufacturer. Can the formulation be modified to give greater freedom from wear? What are the effects of process variables on tool wear? What types of materials are best from this standpoint? What are the effects of pressure and temperature on tool wear?

Obviously, the answers to these questions are not easily obtained. The material supplier might, of course, devise a test mold and run it until wear occurs. Such a test would be extremely time-consuming and would not lend itself easily to a thorough investigation of all the factors involved in mold erosion. Due to the cumbersome nature of such a test, the best he could hope for would be a study of a few isolated variables. What is obviously needed, on the basis of calculations, is a test which would detect one part of mold steel in twenty million.

With the growing knowledge derived from nuclear physics, a method of detecting and measuring minute metal particles through radioactive tracer techniques suggests itself.

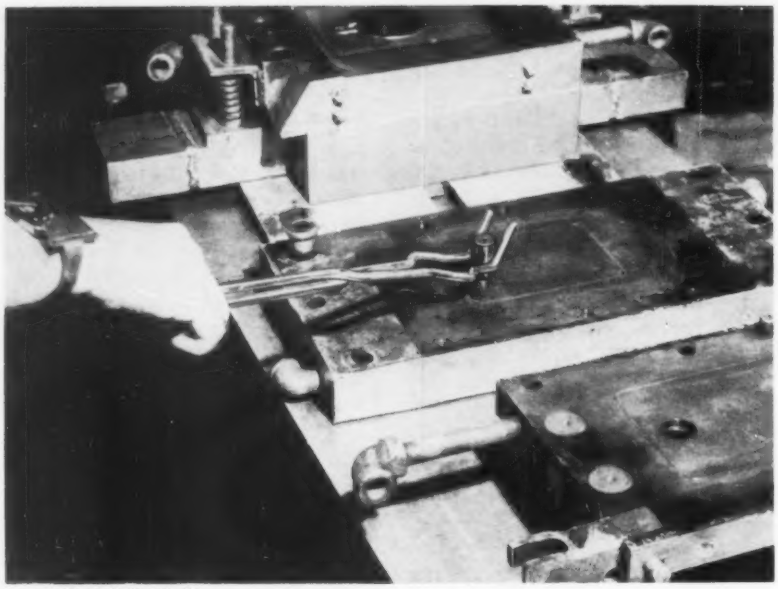
First consideration was given to using a drinking tumbler mold which might duplicate, in miniature, a television cabinet mold. We were counseled against using a completely radioactive mold since the cost of activating such a large mass of steel would be prohibitive. Furthermore, the hazard to personnel with such a large radioactive mass would be very difficult to overcome.

It was decided, therefore, to employ a transfer mold of the type employing a sprue bushing for transfer



Courtesy Improved Machinery, Inc.

Details of floating nozzles and cross head used in external hot-runner molding. While the components as shown here are designed for two-cavity operation (molding tumblers), they can be readily adapted to single- or multiple-cavity injection molding



Courtesy General Electric Co.

Sprue bushing, irradiated to provide source of gamma radiation for measuring mold erosion by radioactive tracer technique, is positioned in one section of a transfer mold

of material through the runners and gates and into the part.

The level of radioactivity required for accurate counting is a function of the mass of the material to be activated. Also, it was necessary to keep the mass as small as possible in order to keep personnel hazard at a minimum. The sprue bushing employed weighed approximately 100 g., which appeared to be a satisfactory mass to handle easily.

The bushing was irradiated in an atomic pile at an average thermal flux of 4×10^{12} neutrons per sec. cm.^{2} until approximately 37 millicuries radiation was obtained.

The part to be molded consisted of a slug 2 in. in diameter by 2.5 in. high. Survey with monitoring devices indicated that if personnel stayed at least 12 in. away from the mold, the radiation would be less than 300 mr. per 40-hr. week—which is a safe weekly dosage.

The test was run by pilling the material and preheating it in a dielectric preheater. The charge to the mold was handled with tongs and the press closed. After sufficient curing time (3¼ min.), the mold was opened, the cull pushed off with a long brass rod, the part removed with tongs, and the mold blown clean with an air blast. This cycle could then be repeated for as many variables as required.

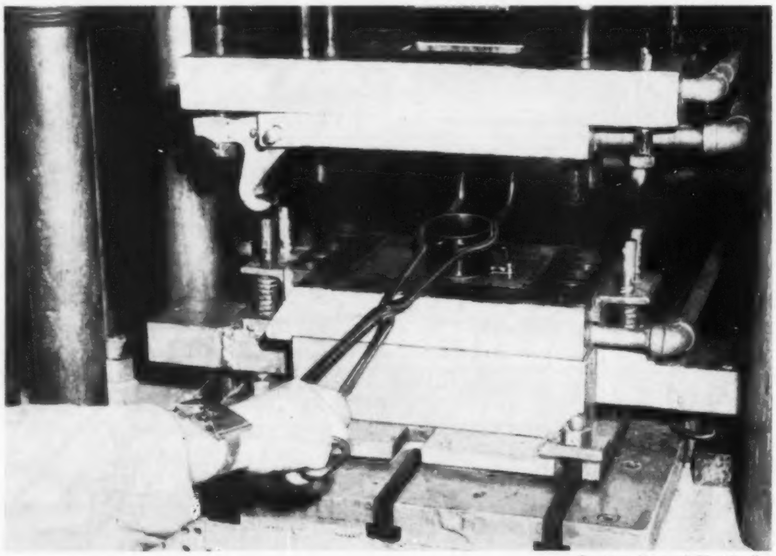
As the material flowed through the sprue bushing, it picked up minute quantities of radioactive metal. This quantity varied, depending on the erosive characteristics of the material being molded.

From the foregoing description of the test employed, it can readily be understood that the time required for one complete mold erosion test is in the order of 30 min. as opposed to approximately three weeks for any other material.

This leads to some of the factors in molding materials which influence mold erosion and factors which might have no appreciable effect on erosion. It has been said that talc causes mold erosion. We have found that the incorporation of talc in moderate amounts can have a marked effect on mold erosion. In the amount normally used as a mineral modifier, talc can raise the erosion rate up to 20 times that of a material containing no talc. It should be remembered that talc is the lowest mineral on the Mohs scale of hardness. Other minerals which might be higher on the Mohs scale might exhibit a relatively low rate of erosion. Apparently, erosion is tied in with crystal structure and not with hardness alone. Some pigments used in the coloring systems of colored materials also have been found to exhibit high rates of erosion when they are compounded into molding materials.

Considerable work has already been done to determine whether or not resin modifications have any effect on mold erosion. It can be said that there appears to be no significant change in erosion rate with changes in the type of phenolic resin used. Materials which might be added to resins to aid in grinding or to inhibit caking may have a marked effect, however.

The lubricants evaluated, oddly enough, do not have any effect on



Courtesy General Electric Co.

Amount of radioactive metal in molded slug being removed from press indicates mold-erosive quality of material; metal is picked up by material flowing through sprue bushing

erosion rate. They do not tend to improve the erosion characteristics of phenolic molding materials. Various lubricants have been free-blended into molding compounds in amounts of 1% with no change in erosion rate. The erosion rate of material containing blended-in lubricant is exactly the same as compound which has no extra free-blended lubricant.

The molder might naturally ask what he can do from the standpoint of molding techniques to reduce erosion. Generally speaking, erosion rate is at a minimum with the lowest possible pressures and the optimum preheat. Mold temperature does not influence erosion except as it allows lower pressures to be used in the molding operation.

Even though it is too soon to say for certain, initial results indicate that the radioactive tracer technique for determining mold wear gives a true picture of actual mold wear.

(A. P. Landall, MODERN PLASTICS, Sept. 1954.)

Cellular Polyethylene

FOR certain applications requiring low-loss behavior beyond that of solid polyethylene, a material capable of being foamed to a cellular form has been developed by the Bakelite Laboratories and is now available for a large variety of industrial as well as commercial applications.

By combining polyethylene having a dielectric constant of 2.3 with a blowing agent which yields an inert gas having a dielectric constant of approximately 1.0, a composition of matter having a constant between these two values is obtained. Normal extrusion equipment does an excellent job and only a few changes in conventional operating procedure are necessary to produce a good product.

Aside from its normal operation, the extruder used for this purpose must perform two additional functions. The first is to cause the blowing agent, by application of heat, to liberate the gas. The second is to maintain sufficient pressure in the barrel, head, and die to prevent expansion of the liberated gas before it emerges from the die. When the machine is performing correctly, the product has a smooth surface, a uniform bubble size, and a unicellular structure.

Machines having a screw length-to-diameter ratio of 12 to 1 or better have been found more effective than extruders having lower ratios. The best machine conditions are those which give the lowest density at the lowest compound temperature. To determine the optimum conditions for a particular extruder, it is recommended that the barrel and head temperatures be set at 300 and 250° F., respectively, and the density of the product measured. The barrel and head temperatures should then be raised in 25° F. increments until a product density of 0.47 is achieved. Operating temperatures higher than necessary will give less uniform bubble size and rougher surface, and will increase the difficulties encountered during the cooling cycle.

Several other factors, which are not normally encountered, must be considered in the production and extrusion of cellular polyethylene. To insure pressures in the barrel sufficiently high to prevent premature expansion of the gas, a dense screen pack is needed. Screen packs of 20/60/100/100-mesh screens have been effective. Head and die pressures are kept high by using a low head temperature and a die designed to restrict the flow of the material; that is, as the annular opening between the wire or core and the die increases it is necessary to increase the die land length to prevent expansion. The exact length will vary with the machine and the optimum operating conditions. Premature expansion makes itself apparent by die plating or curling of the compound on the face of the die. This is accompanied by a rough surface on the extruded material.

When properly extruded, cellular polyethylene will expand 100%, or to double the volume of the unexpanded material. Therefore, when coating wire, for example, the area of the die opening with the wire in the die must be 50% of the area of the finished insulation. A convenient formula for computing the final diameter for a given die size or the die size from the final diameter for a circular cross section is

$$D = \sqrt{2D_1^2 - d^2}$$

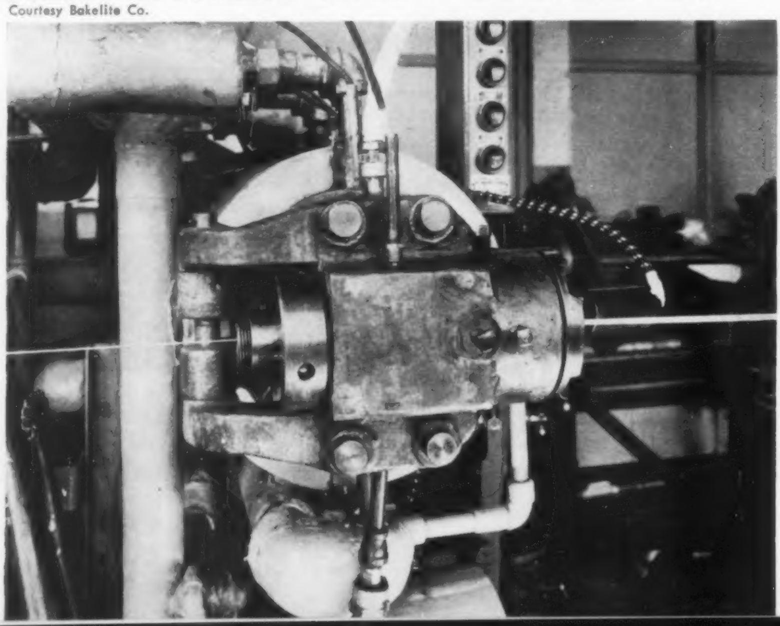
where D = final diameter, D_1 = die diameter, and d = diameter of wire or core.

The screw temperature should be maintained at approximately 212° F. Lower temperatures result in uneven heating while higher temperatures cause the compound to stick to the screw and reduce output. High compression ratio screws have been slightly more effective than those having a low compression ratio.

To insure a smooth, regular surface when wire coating, the wire should be preheated to 100 to 125° C. Lower temperatures give a lumpy product while higher temperatures result in erratic cooling and flattening of the insulation.

The cooling of the finished wire is

Bare wire enters extruder cross head from left and emerges at right coated with cellular polyethylene. Wire is preheated to 100 to 125° F. to insure smooth plastic surface
Courtesy Bakelite Co.



often difficult. For thin wall insulations, direct water cooling is possible. Where heavy walls are involved, a long stretch of air cooling is desirable. If the product is quenched too rapidly it will flatten due to the weakness of the extruded coating at the extrusion temperature. Rapid contraction of the occluded gases before the polyethylene has developed strength, contributes to the deformation of the insulation. Both these tendencies are minimized by using the lowest possible compound temperature.

A higher density than 0.47 may be required for many applications. This can readily be achieved by blending the cellular stock with a solid polyethylene compound to obtain the desired density.

The unique properties of cellular polyethylene, the economies to be gained by reduction in cable size and weight, and its ease of handling in modern extrusion equipment should prove of great advantage and considerable benefit in many electrical applications.

(W. T. Higgins, MODERN PLASTICS, March 1954.)

Courtesy Owens-Corning Fiberglas Corp.

Press line for the production of fibrous glass-reinforced plastics automobile bodies consists of 25 compression presses, the largest one having a 7- by 12- ft. platen area

New Plant for Car Bodies

THE 84 molded reinforced plastics parts which comprise the body of the first high-production sports car are all being made in compression molds at Molded Fiber Glass Body Co., Ashtabula, Ohio.

When the project of building and equipping a plant expressly for the high-speed manufacture of automotive body parts was first discussed, it was found that much of the necessary equipment would have to be specially designed.

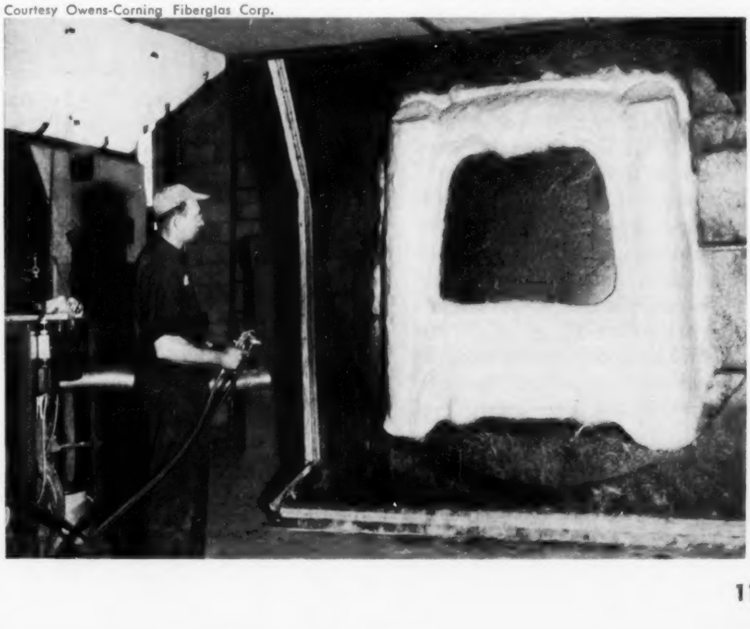
Well over a year was required to complete the design and building of the equipment, the building of the plant, and the installation of the various presses, preformers, ovens, pumps, boilers, and other machines.

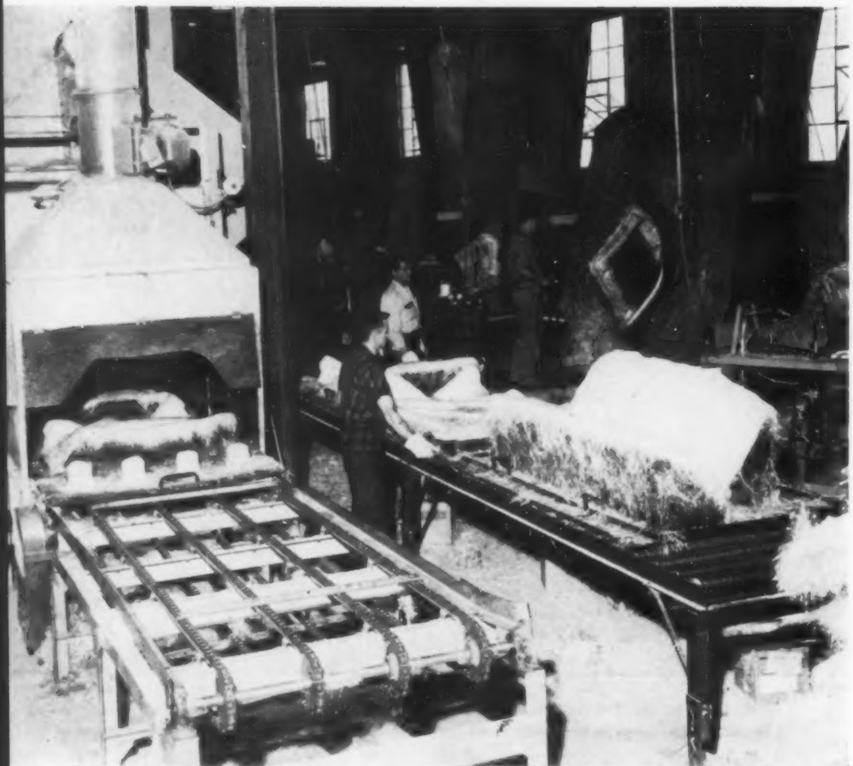
The plant, with a floor area of 34,000 sq. ft., now has in operation six special preformers of a medium size on which preforms up to 20 sq. ft. in area can be produced; two larger preformers having a capacity of 40 sq. ft.; and one very large unit on which preforms up to 100 sq. ft. in area can be made.

The compression presses are set up in two lines, one line consisting of a group of large presses, while the second line is made up of smaller units. Of the 25 presses in this plant, the 10 smallest each have a platen area of 20 by 20 in. between strain rods and a maximum stroke of 21 inches. These 10 units have adjustable daylight openings which may be varied from 24 to 30 in., and operate at 18 tons on the 2000 p.s.i. line pressure available from the accumulators. Each of six other presses has a platen area of 42 by 48 in., a stroke of 50 in., adjustable daylight from 42

Preform screen for large car body part has been sprayed with glass and bonding emulsion; operator used spray hose to his left to deposit glass, spray gun to deposit the resin

Courtesy Owens-Corning Fiberglas Corp.





Courtesy Owens-Corning Fiberglas Corp.

Plastic car body components are preformed on spray-type preformers (background) and cured in ovens (left foreground); at right is seat bulkhead preform still on its screen

to 70 in., and furnishes 100 tons of pressure. In addition, there are six more presses, each of which has a platen area of 54 by 50 in., with 50 in. maximum stroke, and adjustable daylight from 56 to 80 inches. These presses are also 100-ton units. Each of two very large presses has a platen area of 96 by 96 in. and a 50-in. maximum stroke. These are 400-ton presses and have adjustable daylight from 58 to 80 inches. The largest press is really huge for the plastics industry. It is a 600-ton unit with a platen area of 7 by 12 ft., a maximum stroke of 50 in., and adjustable daylight from 58 to 80 inches.

All molds which are used in these presses are cored for steam circulation, except some shallow dies which are mounted on steam-heated plates. Steam is furnished from two boilers, one having a capacity of 40 and the other of 50 horsepowers. These boilers are heated by natural gas and are operated at a line pressure of 50 p.s.i., which figures out to a temperature of 280° F. Pressure reducers are used at each press to secure the desired temperature.

Setting up of the bonding resin on the large preforms is accomplished with the screen and preform still mounted on the turntable of the preformer. An ingeniously counterweighted door, hinged at the top of the preformer, is so mounted that it can be swung down on the preform to completely enclose it. Natural gas direct-fired units supplying 1.5 million B.T.U. furnish the necessary heat for the short time necessary to set up the emulsion, after which the door is opened and the preform removed from the screen. This ingenious combination of oven and preformer in one unit eliminates the problem of handling large and heavy screens.

In discussing the future of operations at Molded Fiber Glass Body Co., its president, Robert S. Morrison, commented with the following statements:

"The over-all future of reinforced plastics in the automobile industry will depend on cost, quality, finishing, and assembly, and productive capacity per set of dies. At the present time, it appears that the annual productive capacity for one complete set of dies to make all the parts for a car body is about 20,000 cars. However, it might require only four more sets of some of the larger dies, out of the approximately 75 dies now in use, to increase this production rate from 20,000 units to 40,000 units per year.

"Based on present prices, the break-even point, including tool amortization of a molded reinforced plastics car body as compared to a steel car body, is about 15,000 units. We hope, through economies made in our plant and by our materials suppliers, to bring this break-even point up to 25,000 units.

"If further progress can be made, the market for reinforced plastics parts in the automotive industry could increase several times."

(MODERN PLASTICS, August 1954.)

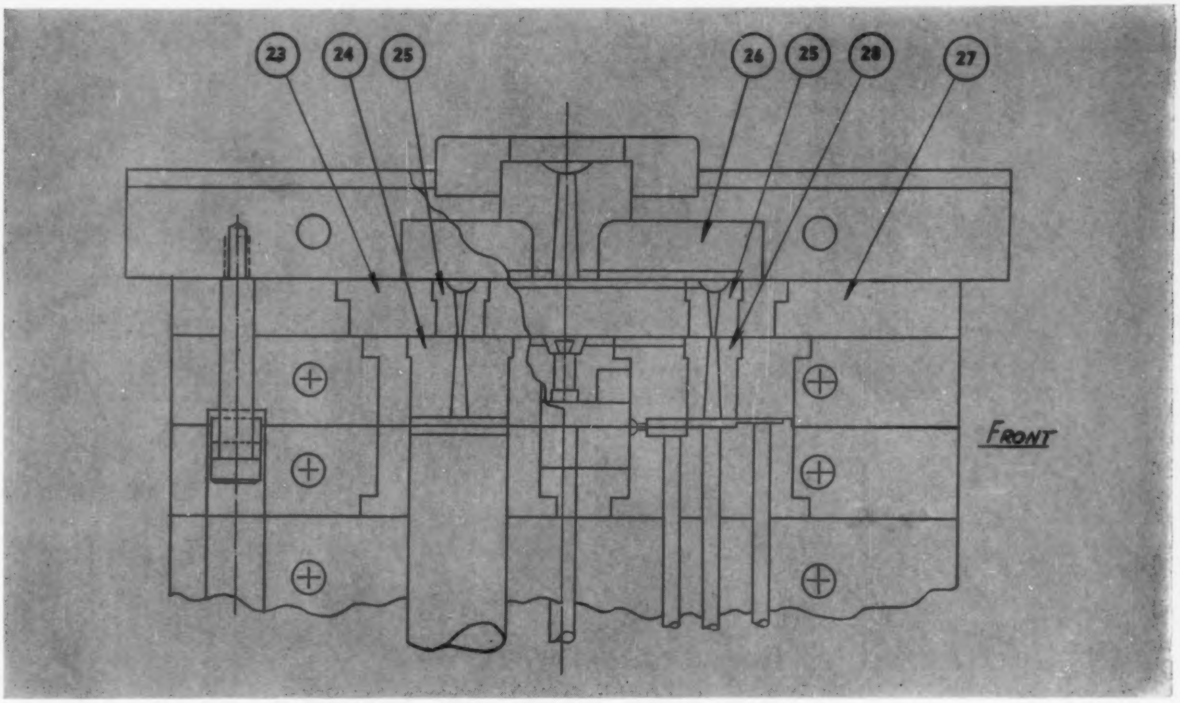
Up-Grading Fluorocarbon Moldings

THROUGH recent developments in the use of hot-runner molds for injection molding of Kel-F, it now appears possible to minimize scrap, reduce material degradation, and produce higher quality molded pieces with less orientation.

When injection molding Kel-F thermoplastics, the material must be at a temperature which is just below that of rapid degradation, yet high enough for proper plasticization of the material.

If the material is not completely flowable or cools to a point below its flow temperature while flowing through the sprues, runners, and gates into the cavity, Kel-F polymer plastic will then become oriented to a varying degree, depending upon the conditions of the injection operation.

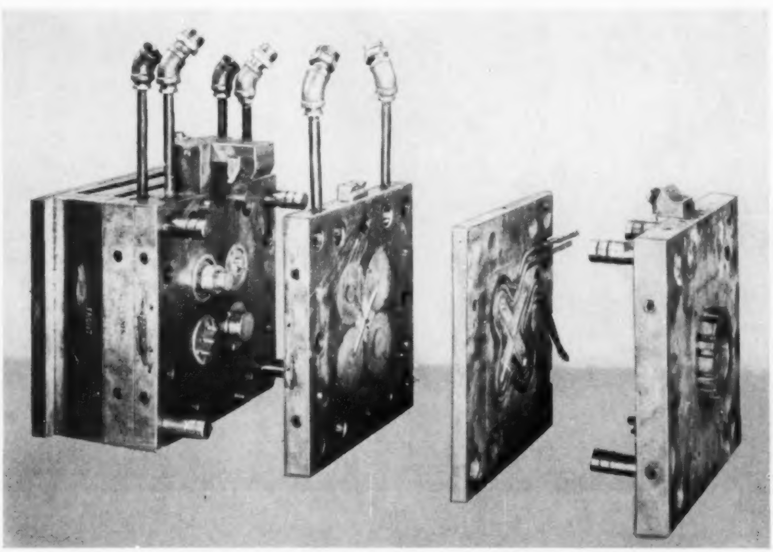
During some of the early work with injection molding of Kel-F material, by reason of economy and experimentation, single-cavity molds were used. It was noted at this time that single-cavity molds appeared to produce parts with better physical properties. In a single-cavity mold, the material is fed from the injection machine nozzle, through a very short sprue bushing, directly into the cavity. When multiple-cavity molds were constructed for the same part, sometimes parts



Schematic diagram of four-cavity mold set-up for hot-runner molding of polychlorotrifluoroethylene. Mold components are identified as: 23—runner plate insert; 24—cavity bushing; 25—feed bushing; 26—runner plate insert; 27—runner plate; 28—cavity bushing

from the multiple-cavity mold did not appear to have the same physical characteristics as those from the single-cavity mold. It also appeared that the degree of control necessary with multiple-cavity molds was considerably greater than that required for a single-cavity mold. At that time, it was believed that if Kel-F could be maintained in a flowable state while traveling through the sprue bushing, runners, and gates in a multiple-cavity mold, in essentially the same manner as in a single-cavity mold, better parts could be obtained.

Therefore, a four-cavity hot-runner laboratory mold was designed and constructed. This mold was designed to be operated as a side-gated mold, as a center-gated mold with a removable runner system, or as a hot-runner mold. The purpose in doing this was to determine if the physical characteristics of parts produced by a hot-runner mold could be improved over those produced in a conventional side-gated or three-plate mold.



Four-cavity experimental hot-runner mold consists of the following parts: rear half (extreme left), and front half, comprised of front cavity plate and runner plates

With the use of a hot-runner mold, the material traveling through the cylinder and nozzle, into the sprue bushing, and through a system of runners and gates, can be maintained at a temperature which is substantially above the flowable temperature of the plastic material. This would have the effect of converting the nozzle of the press and extending it to 2, 3, 4, or as many nozzles as required. This would allow the material to remain in the flowable state up to a point which would be the entrance to the cavity. Therefore, the material would be traveling from the nozzle, into the cavity, with a minimum drop in temperature.

This type of operation has many advantages; some of them are:

1) The hot-runner system is de-

(*To page* 116)

Courtesy Majestic Creations, Inc. of Woodside, L.I.

From the Marblette phenolic die on the press, efficient mass production of seasonal items occurs rapidly and economically—with minute detail faithfully reproduced to register exactly with designs preprinted on thermoplastic sheets.

signed to effectively contain the same weight of material as required in the molded pieces. This means that the injection cylinder acts as a preconditioner to gradually bring the material up to a temperature which will render the material flowable without excessive degradation. The final rendering of flowability is then done in a hot-runner system just prior to injection into the cavities.

2) For the hot-runner system, the scrap resulting from sprues, runners, and gates is reduced to a minimum.

3) With the hot-runner mold, 100% virgin material is used.

4) Higher quality, less orientation, and higher molecular weight parts with the optimum physical properties of Kel-F are produced by use of a hot-runner mold.

The mold design shown in the drawing on page 113 is a suggestion only; there are many other designs incorporating multiple-nozzles and hot-runner molds possible.

The cavity plate is separated from the runner plate during the open period of each cycle in order to minimize transfer of heat from the hot-runner plate. The hot-runner plate is normally operated at a temperature of approximately 525° F., the cavity plates being maintained at about 300° F., and the injection cylinder at 525 to 540° F.

When the four-cavity experimental mold is used as a hot-runner system, the gate diameters are 0.062, 0.090, and 0.125 inch. It is found in general that the larger gate produces the best pieces with minimum orientation and highest molecular weight.

(Carmen R. Giannotta, MODERN PLASTICS, October 1954.)

Polyester-Glass Compounds

COMBINING glass and polyester resins to make a molding compound is easy to accomplish, and simple parts can be molded from many combinations of these materials. Most parts are not simple, however, and require considerable ingenuity on the part of the designer, compound manufacturer, and molder to assure a happy and satisfied customer.

The physical state or condition of the molding compound is one of the most important aspects of a successful commercial operation. For the purpose of this discussion, all glass-polyester compounds will be considered as falling into one of two types: the putty type or the straw type. True, there are many materials that fall somewhere between these two types, but there seems to be very little real justification for the use of such in-between polyester-glass materials from the molder's point of view.

The putty type of compound is one that can be compressed easily into a shape by hand and will hold that shape indefinitely when the pressure is relieved. This material, when properly compounded, will be non-tacky to the touch. It is capable of being preformed by extrusion and cut into any conventional simple shape prior to molding (see Fig. 1, below).

In general, the glass content of putty-type compounds will not exceed 35% by weight and most frequently they will contain only 5 to 20% glass fibers. The low-glass-content materials generally have exceptionally large amounts of fillers and as such are probably the lowest-cost glass-polyester molding materials available.

As a general consideration, it is desirable to compression mold glass-polyester compounds rather than to use transfer molding. Therefore, a putty-type material should be pre-

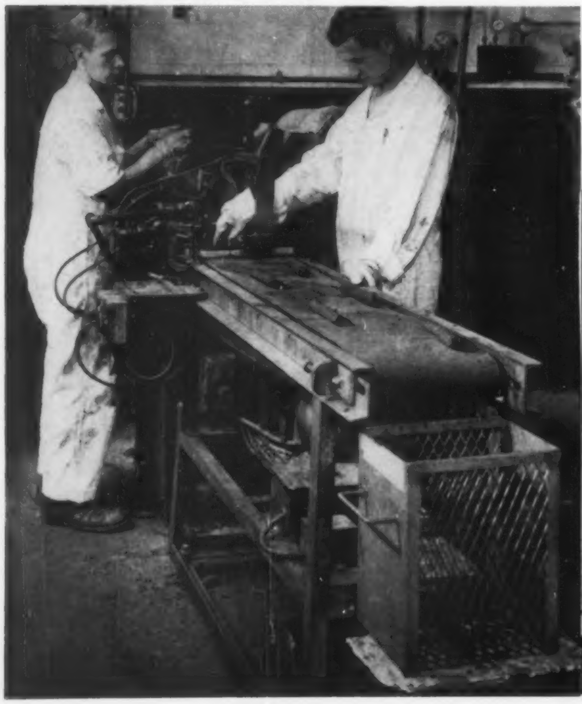


Fig. 1 (left)—Non-tacky preforms of putty-type polyester-glass compound are made by extruding the material, then cutting it to length

Fig. 2 (below)—Straw-type molding compound consists of loose, random-chopped glass fibers coated with resin and filler

Photos courtesy Westinghouse Electric Corp.

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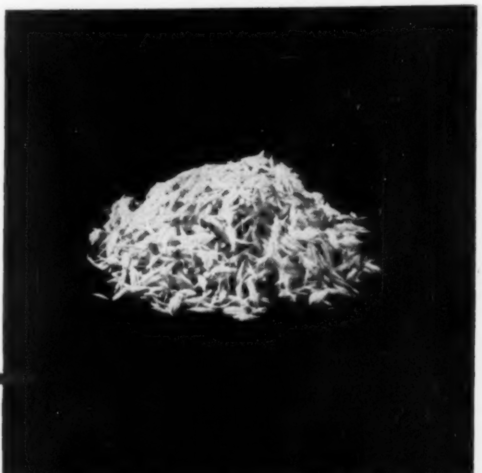


New melamine-glass material above, original compound below. Note reduced bulk factor.

A new and improved melamine-glass high-impact material with exceptional molding and electrical properties

MELMAC Molding Material 3135, a product of Cyanamid's continuing program of product development, offers you for the first time an impact material that is readily moldable, with exceptionally high arc and flame resistance.

MELMAC 3135 can be compression- or transfer-molded – in small or large parts – with equal facility. It flows so well that even intricate and thin-sectioned parts can be molded without "shorts." And it can be preformed and preheated.

MELMAC 3135 meets all requirements of MMI-30, MIL-P-14 – is ideal for heavy duty electrical application including switch gear or circuit breakers, sockets, terminal blocks and strips, coil forms, stand-off insulators and connectors.

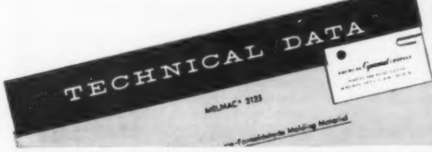
Here are just a few of the important, distinctive properties you get in MELMAC 3135:

Impact strength (ASTM)	4.0-6.0 Ft. Lb./in (Izod)
Arc resistance (ASTM)	183-186 Seconds
Flame resistance (ASTM)	Excellent (self-extinguishing)
Heat distortion point (ASTM)	400°F
Dimensional stability	Excellent

AMERICAN *Cyanamid* COMPANY
PLASTICS & RESINS DIVISION
32 Rockefeller Plaza, New York 20, N. Y.

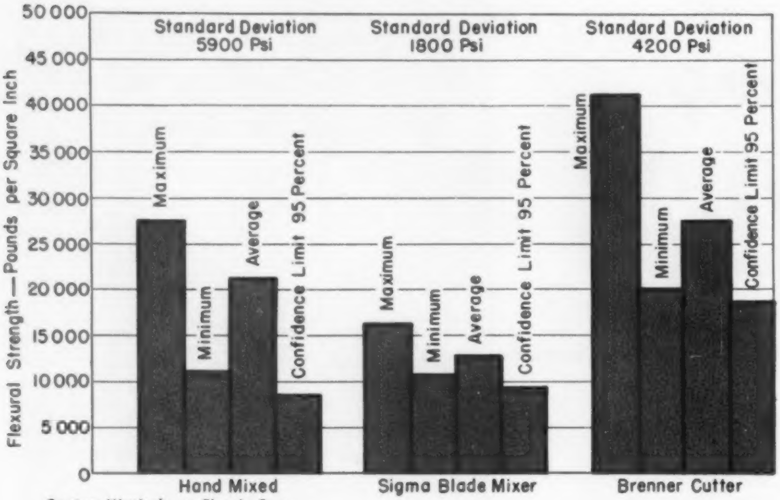
In Canada: North American Cyanamid Limited, Toronto & Montreal

***MAIL THIS COUPON—*FOR ADDITIONAL TECHNICAL INFORMATION**
— including properties, test data, information on molding, shrinkage range, preforming and preheating, storage and handling, finishing.



AMERICAN CYANAMID COMPANY, PLASTICS AND RESINS DIVISION
32 Rockefeller Plaza, New York 20, N. Y.
Gentlemen: *Please send me complete technical data on MELMAC 3135.*

Name__________ Title__________
Address__________
Company__________
City__________ Zone_____ State__________



Courtesy Westinghouse Electric Corp.

Fig. 3—Differences in flexural strength due to differences in manufacturing procedure

formed into a shape that will conveniently fit the mold cavity so that only a minimum amount of flow is required. The amount and direction of flow must be controlled by the shape of the preform and the flash lines in the cavity to wash all of the air from the cavity in order to avoid the development of an undesirable flow pattern.

Putty-like compounds can be molded in various types of molds including positive, semi-positive, and landed positive molds. The type of mold selected will depend primarily on the size and shape of the part to be molded. It is often difficult to obtain suitable moldings from flash-type molds, since the high flow characteristics of the material make it impossible to develop enough pressure on the material.

The straw-type compounds are loose, random-chopped fibers coated with resin and filler (Fig. 2). They are characterized by a relatively high glass content (from 30 to 60%), are fairly dry and nontacky, and are generally made using high-viscosity or crystalline-type resins. These compounds have high strength compared with most putty-type materials. They are more difficult to preform, since individual preforms must be made by a compression procedure.

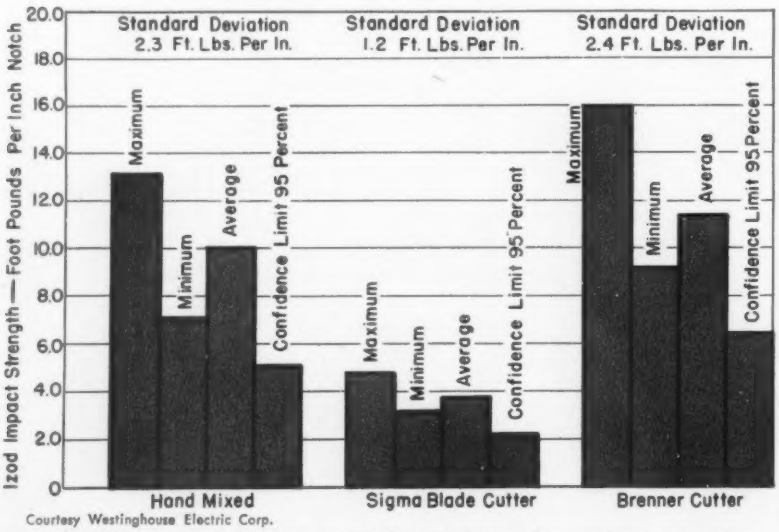
The major advantage of a straw-type compound is that, in loading the mold, the glass is well distributed throughout the cavity due to the large bulk factor of the material.

The method used for incorporating glass fibers in the resin is one of the most important variables in controlling properties of the finished polyester molding compound. Several machines were tried and found to be unsatisfactory from a manufacturing standpoint. These included a mix muller, vertical propeller, and vertical dough-type mixer. These machines were abandoned primarily because of problems encountered when the glass was added to the other components. A sigma blade mixer and Brenner cutters[1] were found to be the most satisfactory blenders.

The sigma blade mixer was used in a batch process to prepare from 100- to 400-lb. quantities. Component materials were added in preferred sequence and mixed until the compound was uniform. This process was relatively trouble-free but resulted in a low-strength-class polyester compound.

The Brenner cutter was used for continuously coating and cutting glass roving. The nature of this process made it necessary that a relatively fluid coating resin composition be used.

Hand mixing was investigated as (*To page* 203)



Courtesy Westinghouse Electric Corp.

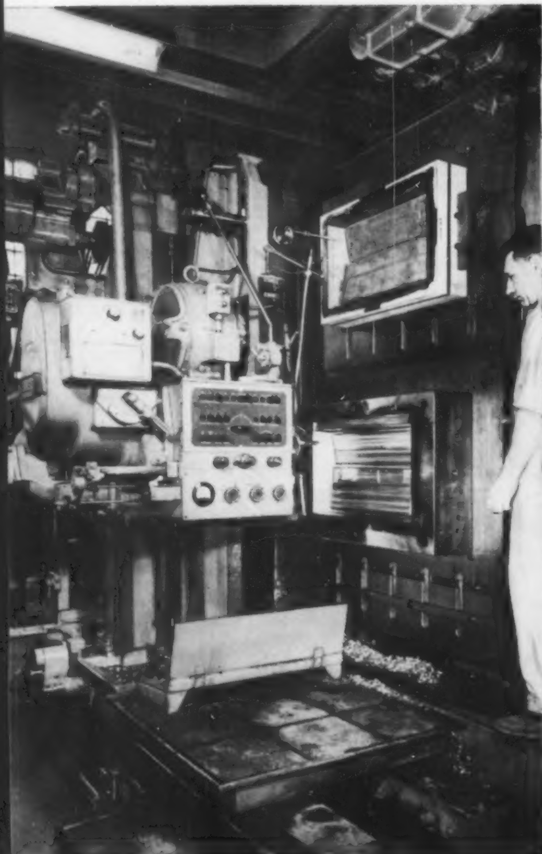
Fig. 4—Differences in Izod impact strength due to differences in manufacturing procedure

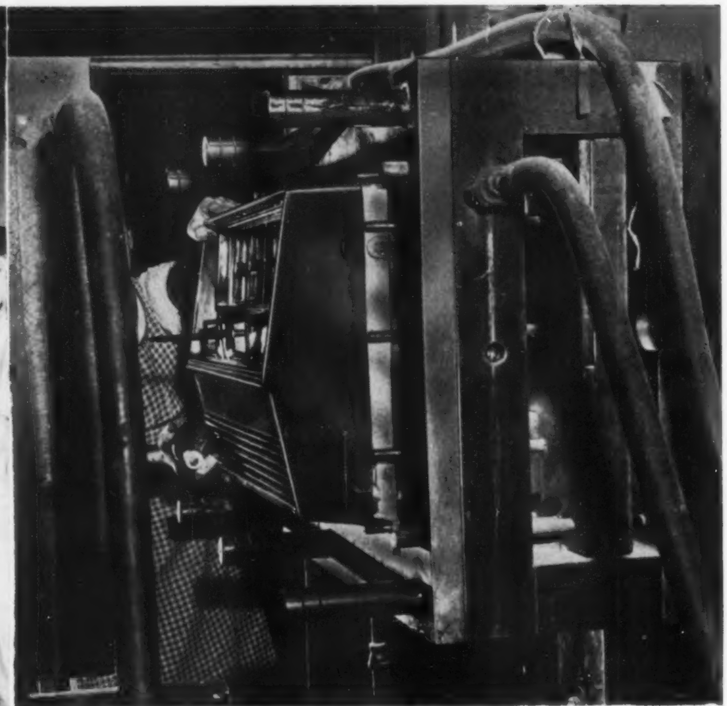
Solving Big Mold Problems

MOST mold makers have kept abreast of the times by installing machine tool equipment for handling extra large forgings; now at least one large supplier of forgings, Latrobe Steel Co., has developed a steel which is not too hard to machine, but still is hard enough to withstand the high pressures used in molding. Also, it will take a high polish after machining. Forgings of this new material, which is known as Cascade and is a precipitation-hardened, low-carbon, aluminum-nickel tool steel, Rockwell from 34 to 36 on the C scale.

One of the first molds made from this new steel was a single-cavity

[1] The Brenner cutter was developed by I. G. Brenner, formerly of Owens-Corning Fiberglas Corp., Newark, Ohio. Mr. Brenner is now owner of I. G. Brenner Co., Newark, Ohio.





Photos courtesy Newark Die Co.

Air-conditioner grille is removed from force plug of single-cavity mold. Knock-out pins have pushed molded part nearly off force plug to facilitate removal

Keller die-sinking equipment producing mold component for air-conditioner grille; stone pattern and tracing apparatus is at top, partly machined cavity below

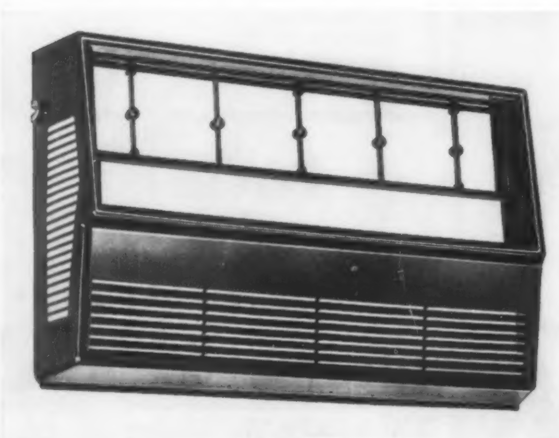
injection mold for a large grille measuring 26 in. long, $15\frac{1}{2}$ in. wide, and $4\frac{3}{4}$ in. deep, with an average wall section of 0.100 inch. This grille was for a Philco air conditioner manufactured by The York Corp.

The molder, Bridgeport Moulded Products, Inc., placed the order for the mold with Newark Die Co., the specifications stating that no flashing could be tolerated. Not too long before this order was placed, Newark Die might not have accepted such a stipulation without increasing their price to cover possible added costs due to warping of the mold. However, at the time of negotiations for building this mold, the mold maker had become familiar with the new prehardened steel which did not require heat treatment after machining and which would eliminate warping and cracking.

The latest theory (now proved by experience) is that large-area parts are molded better when the material is injected into the mold in as short a time as possible. The fact that this mold was going to be run in one of the latest-design H-P-M 200-oz. machines, which have a very high injection speed (on the order of 200 oz. in 3 sec.), was just another reason why the mold steel used had to have a very high strength. Since Cascade has a uniform yield strength of 164,500 p.s.i., Newark Die had no misgivings about building this mold and guaranteeing "no flashing."

During the time the forgings were being prepared, an expert pattern maker was producing an accurate wooden facsimile of the part to be molded. This male pattern was made somewhat larger than the required plastic part by an amount equal to the known shrinkage of the Dow 475 material of which the grille was to be molded.

The finished wooden model was



Courtesy Philco Corp.

Louver openings in one-piece cabinet front of $\frac{3}{4}$-hp. home air conditioner are molded flash-free because of accurate mating of the mold components

placed in the center of a rectangular wooden form prior to pouring in a special stone mixture called Tamastone, made by Tamms Industries, Inc., Chicago, Ill. After the form had been completely covered with sufficient material to provide the required strength, it was permitted to set for about 12 hours.

The cast was then carefully removed from the male pattern and the sides and bottom squared up. This casting was then used as the master pattern for the die sinking of the mold cavity while the original wooden model was used as the pattern for the force plug.

It is generally thought that machinability is pretty much a matter of material hardness; that is, the harder the steel, the harder it is to machine. This is true to some extent,

(*To page* 204)

Economy in Record Molding

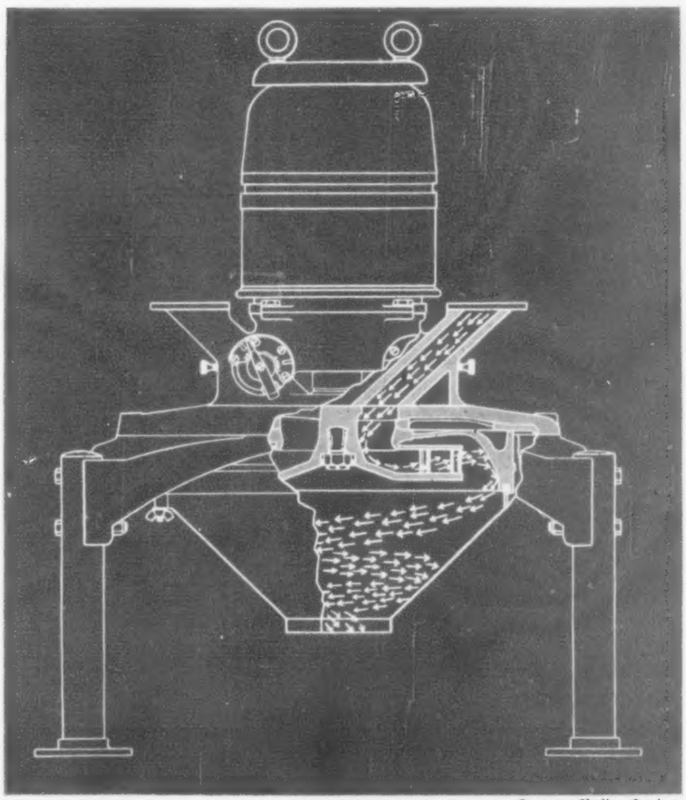
THE problem of reducing costs in dry-coloring styrene intermediate material for molding phonograph records led to an investigation of all kinds of mixing equipment. During the course of this search, the writer came across reference to a centrifugal mixer made by Entoleter Div., The Safety Car Heating & Lighting Co., Inc., New Haven, Conn. Original use for this mixer, developed several years ago, was for killing weevils in wheat flour. The Entoleter mixer has an enclosed motor connected directly to a specially designed high-speed mixing rotor. This rotor consists of two steel disks spaced about 1 in. apart by specially designed impactors. The material enters the inlet (see drawing at right) and is directed to the center of the rotor from which it is spun out by centrifugal force into a film which thins out as it approaches the rotor perimeter. The material, mixed by this action, is discharged through the hopper in the bottom of the unit.

During a visit to the demonstration laboratory of Entoleter Div., several preblended samples of dry-colored material were run through the mixer. The results were so satisfactory that a set-up consisting of a ribbon-type batch mixer, or preblender, a screw conveyor feeder, and an Entoleter "Big Inch" mixer was immediately ordered. The screw conveyor is used to transfer the material from the batch mixer to the centrifugal unit. This equipment has been in operation for several months and very satisfactory results have been obtained, as evidenced by the clarity and freedom from streaks and color splotches.

In the same plant where the above described dry-coloring system is in use, an ingeniously designed set-up for molding styrene phonograph records on a fully automatic basis is also employed. The injection machine is a small Impco having a vertical clamp and horizontal injection. The record molds are center-gated. After injection, a round pin of the diameter of the hole in the record is forced upward through the center of the record by the lower hydraulic ram of the press. This rod not only pushes the hot sprue and runner back toward the nozzle but, at the same time, pierces a clean center hole in the record. As the mold opens, the record sticks on the lower stamper. A vacuum cup is then carried forward between the mold halves by a pneumatic cylinder. When directly above the record, the arm which carries the vacuum cup drops slightly so that the cup is in contact with the record. A vacuum is then automatically pulled, attaching the record firmly to the underside of the cup. The arm then raises slightly, pulling the record away from the lower stamper, after which the arm retracts from between the mold halves. In this retracted position, the center hole of the record is directly above one of four pins mounted on an indexing table. When the record and cup have reached this position the vacuum is automatically broken, and the record drops onto the pin.

The reason for the four stations on this indexing table is that the speed of molding is so high that if the records were all piled on one pin they would not have time to cool sufficiently and would warp.

(Clark Galehouse, MODERN PLASTICS, November 1954.)



Courtesy Shelley Products

Schematic diagram of centrifugal mixer used to compound styrene molding material for the production of low-cost, high-quality, colored phonograph records

Machines for Thermoplastics

THE report this year on sales of injection and extrusion machinery is partially good and partially disappointing. The disappointing phase stems from the fact that the injection molding business was not as good in 1954 as it was in 1953. This drop was reflected in the total sales of injection machines, which total is down by 19 percent. (See Table I for comparative figures.)

On the other hand, the extrusion business has been very good and this in turn has been reflected by the approximately 9% increase in sales of extruders. (See Table I.) This 9% increase, however, does not tell the entire story; the sales of extruders up to 3 in. screw size were off 64 machines or approximately 20%, whereas the sales of extruders in screw sizes of 3 in. and over were up 112 machines or over 45 percent. Thus, the added extrusion capacity is far greater than would be indicated by the total machine sale increase of nine percent.

Again on the bright side, the fact is that, even though injection machine sales in 1954 were 19% under '53, they were still higher by far than the sales for any other previous year in the history of injection molding. For example, the total injection machine sales of 977 in '54 was 265 machines higher than '49, 108 machines higher than '50, 409 machines higher than '51, and 213 machines higher than '52.

There is no way as yet of calculating the total effect of vacuum forming on injection molding, but there is no questioning the fact that the increasing use of that process is causing injection molders to lose at least some of their traditional molding jobs.

Some indication of the extent of this effect is shown by the large number of serious inquiries which are received by MODERN PLASTICS on the subject of vacuum forming. Many of these inquiries come from large and successful custom injection molders. They want to know the extent to which vacuum forming can compete with injection molding; what classifications of jobs can be made at the same quality but at a lower price by vacuum forming; is it advisable for them to install vacuum forming equipment in their presently successful injection molding plants? These and many similar questions indicate that the inquirers have already felt, to some extent, the competitive aspect of the vacuum forming process.

The tabulation of injection machine shipments for 1954 (Table II) shows that the drop in sales was evident in all capacities excepting that group listed as "up to 2½ ounce." In this case there was an increase of 75 machines for 1954 over 1953, and in the majority of cases the machines sold in 1954 were in the fully automatic class.

While it is, of course, true that some larger machines are operating fully automatically, the fact that the only sales increase was in the small fully

(*To page* 206)

Table I—Machines in Use and Delivered

	1948	1949	1950	1951	1952	1953	1954
Injection Machines							
Machines in the industry	4102	4814	5683	6251	7015	8204	9181
Machines delivered in year		712	869	568	764	1189	977
Extrusion Machines							
Machines in the industry	1641	1987	2307	2792	3279	3828	4425
Machines delivered in year		346	320	485	487	549	597

Table II—Shipments of Injection Machines

Capacity	Number of machines shipped: Domestic			Export		
oz.	1952	1953	1954	1952	1953	1954
Up to 2½	231	231	306	33	33	33
3-4-6	249	329	262	28	14	25
8-9-10	111	250	115	36	42	29
12-16	107	274	208	2	15	16
20-24-28	31	40	36		2	
30-32	16	29	15		1	2
48-50	10	21	23		2	2
60 and over	9	15	12			1

Table III—Shipments of Extrusion Machines

Screw size	Number of machines shipped: Domestic			Export		
in.	1952	1953	1954	1952	1953	1954
Up to 1½	90	101	81	17	22	20
2-3	177	207	163	58	37	24
3-4	119	136	199	46	20	28
4 and over	101	105	154	16	12	18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complete equipment to produce large quantities of molding and extrusion compounds
DRYCOL
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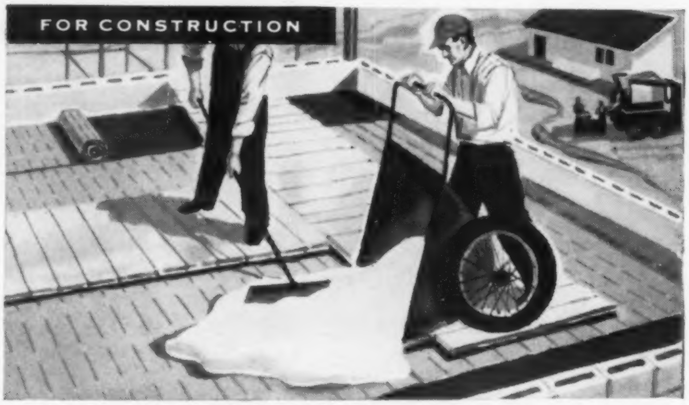
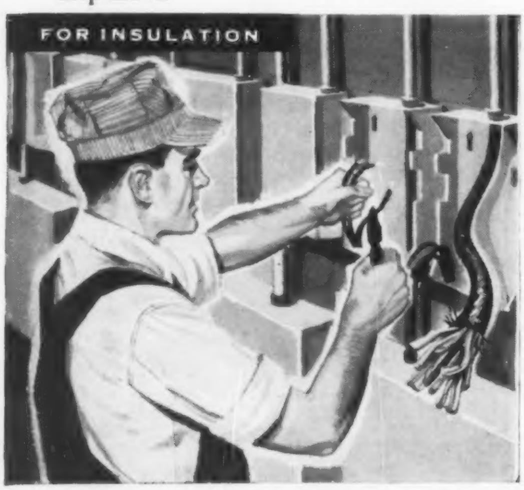
Mosinee impregnating papers replace steel—when treated with synthetic resins to form light, strong, better insulated refrigerator door panels. Mosinee works with many manufacturers to develop impregnating papers of special qualities. In this case, strength and moldability to take deep draws.

Find out how you can get "MORE PROFITS with PAPER"—for laminations, insulation, packaging, protection, fabricating or processing



Mosinee patented reinforced paper simplifies building construction. Easy to handle Mosinee reinforced papers with steel mesh reinforcing attached, replace wood forms for pouring lightweight concrete floors. This is only one of many instances in which Mosinee cooperated in developing new papers to improve processing or production.



Cable wrap of special Mosinee paper winds easily, twists uniformly. Mosinee moisture resistant, extra-strong, electrical cable wrap offers a plus value. Mosinee specialized production controls insure uniformity, minimize problems in high speed twisting and cable wrap operations.

THAT's the theme of a growing number of concerns and industries who have worked with Mosinee experts. They've found Mosinee's more than a quarter century of experience particularly valuable in developing special papers to perform specific functions. They've discovered that Mosinee special papers help complete their product or process faster, easier and usually at less cost.

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PLASTICS*
TECHNICAL SECTION: Dr. Gordon M. Kline, Technical Editor

The Year 1954 in Review

AT THIS midpoint in the present decade, the progress that has been made by the plastics industry during the past five years is worth noting. This reviewer in January 1950 predicted that 1) the emphasis in new commercial plastics would be in copolymers, 2) the trend in new applications would be in semi-structural and structural parts, and 3) the efforts to provide recognized standards for plastic products would result in extension of the markets for these modern materials of construction.

As to materials, this review for 1954 includes reference to only one class of plastics not mentioned in the January 1950 review, the polyurethanes. But there will be many references to new copolymers and new modifications of the older basic types of plastics.

As to applications, the tremendous strides that have been made in the introduction of plastics pipes, ducts, and tanks into the chemical industry, plastics housings and functional components into business machines, household equipment, and air conditioners, and reinforced plastic structural parts into automotive, aircraft, and boat construction are typical of the expanding acceptance of plastics for engineering purposes. R. K. Mueller, vice president of Monsanto Chemical Co., stated at a recent Building Research Institute conference that 400,000,000 lb. of plastics would be used by the building trades during 1954 and that plastics engineers were helping to create new American styles and concepts of architecture.

As to standards, a record was set in the number of Commercial Standards, Federal Specifications, and A.S.T.M. Standards prepared and promulgated during the past five years. Further, the Society of the Plastics Industry has several divisional committees drafting additional industry standards and the American Standards Association has taken the leadership in the preparation of international standards for plastics through the International Standardization Organization. This emphasis on standards of quality has certainly been an important factor in the growth of the plastics industry during the five-year period 1950-1954; it doubled in size, going from an annual production of about 1.5 billion pounds to about 3 billion pounds.

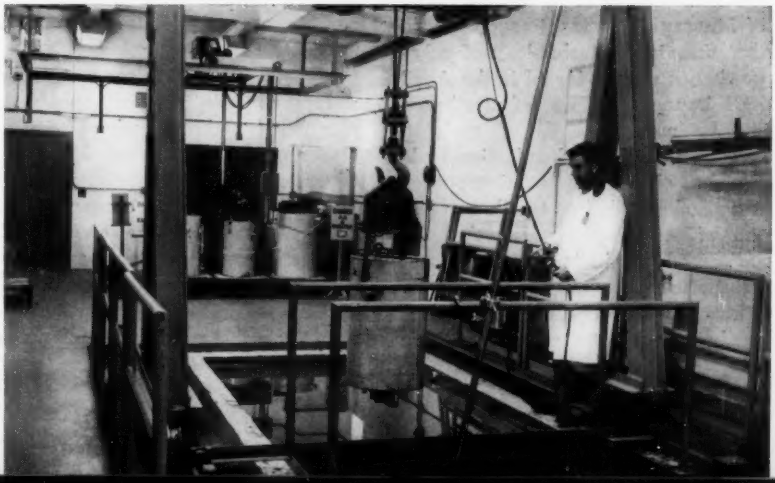
Irradiated Plastics

The growing literature on the effects of atomic radiation in the polymer field foreshadows the coming utilization of atomic energy in the synthesis and processing of plastics. Two comprehensive reviews of the industrial potential of intense radiation fields stressed the facts that 1) initiation can be accomplished at low temperatures, thus permitting polymerization of heat-sensitive monomers, 2) polymerization can be carried out in the solid state, 3) polymers can be made without contamination by catalyst fragments, and 4) the physical properties of polymers can be markedly altered and characteristics imparted that cannot be achieved otherwise. The comparative economics of gamma irradiator reactors utilizing cobalt-60 as the source and particle accelerators such as van de Graaff and X-ray machines were discussed and design concepts of industrial reactors were advanced (1, 2).[1]

Pilot-plant production of irradiated polyethylene (Irrathene) by General Electric Co. marked the emergence of irradiation research from the laboratory. The film is passed continuously through the high-energy electron field of a modified X-ray machine. This treatment converts the polyethylene from a thermoplastic that softens at 165° F. to an infusible material which with proper stabilization will withstand prolonged aging at 300° F. and short-time exposure to 450° F. The material is being evaluated for use in the electrical and food packaging fields, housewares, and bottles (3-6). Other reports dealt with the effects of ionizing radiation on electrical insulation (7), cellulose (8),

[1] Numbers in parenthesis link to references starting on p. 142.

View of an under-water irradiation facility. In this arrangement, radiation sources are placed at bottom of water tank, with the water itself acting as radiation shield



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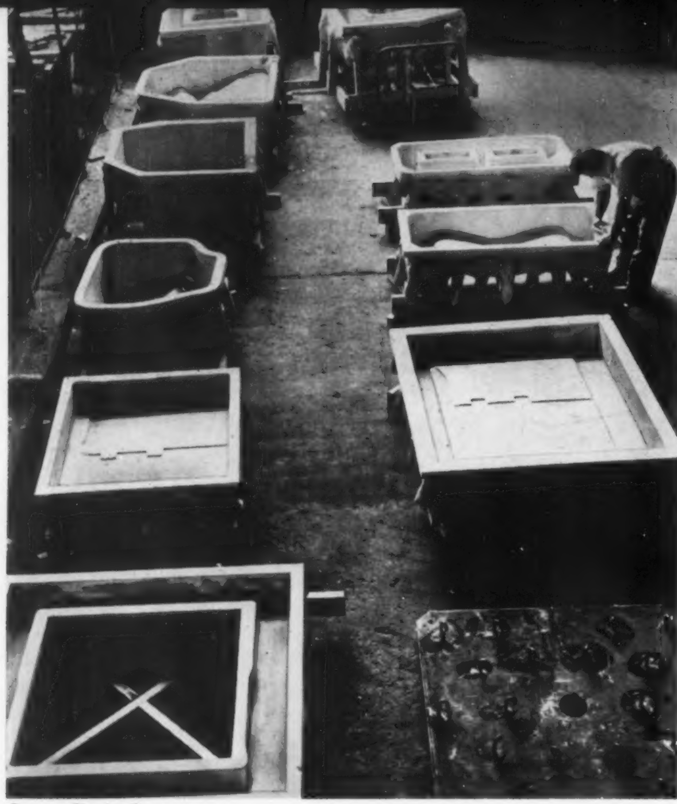


Courtesy Chrysler Corp.

Hardened plaster molds cast to the exact size and shape of the desired plastic tool are ready for the initial lay-up of epoxy resin-impregnated fibrous glass cloth

urethanes by the reaction of isocyanates with glycols and polyols was reported (17).

Epoxy Resins

The annual review published five years ago recorded the appearance of the epoxy resin as a commercially significant new type of plastic in the United States. A recent review of developments in this field stresses two factors that have been responsible for the subsequent rapid rise of the epoxies as a major resin class. The epoxy resins, in their own right, have many desirable qualities and are used unmodified for coatings, castings, potting compounds, laminates, and adhesives. They also have a wide range of compatibility with other resins and are used in combinations to impart special characteristics. These materials may be copolymers of epoxy and other resin-forming compounds or products of reactions of the epoxy compound with other resins. The range of materials that have been combined with epoxy compounds to make commercial products includes fatty acid esters, oils, styrene, furan, urea, melamine, phenols, polyamides, polysulfides, polyesters, vinyl resins, and asphalt (18).

Epoxy resins can be used in glass-fabric laminates that show wet flexural strengths of over 40,000 p.s.i. after 24 hr. at 500° F. (19). The epoxy potting resins provide the electronics industry with more compact, lighter, and cheaper finished units, which no longer require a metal case (20). Other types of epoxy resins are used for tooling (21), splicing cables (22), protective coatings (23), adhesives (24), and elastomeric products (25, 26). The epoxidation reaction is a versatile chemical unit operation which joins chlorination, hydrogenation, esterification, etc., as a means of synthesizing the monomers needed for new and improved types of plastics (27-29).

polystyrene (9), polyvinyl chloride, and polymonochlorotrifluoroethylene (10).

Polyurethanes

Another group of resins soon to become of major commercial significance in the United States is comprised of the polyurethanes. These are based on the reaction of isocyanate compounds ($O{=}C{=}N{-}R_1{-}N{=}C{=}O$) with the hydroxyl groups of glycols or polyesters ($HO{-}R_2{-}OH$), yielding a polymer with the structure:

$$\text{-NH-CO-OR}_2\text{O-CO-NH-R}_1\text{-NH-CO-OR}_2\text{O-CO-NH-}$$

The development of this polymer in Germany during World War II was described in the June 1947 issue of Modern Plastics. Progress since that time in the technology of polyurethanes was reviewed in the April 1954 issue (11). The polyurethanes can be made into fibers, molding compounds, foamed plastics, adhesives, elastomers, coatings; they can also be made into textile treating compositions.

Foamed products are the focal point of current developments in the utilization of polyurethanes; they are being evaluated as a competitive material for many of the applications in which foam rubber is now used. These include bath and household sponges, dishwashing brushes, toys, cushioning, bedding, and upholstery (12). Foamed-in-place polyurethanes are available for insulating home freezers, water coolers, refrigerated trucks and cars, as a core material for radomes, and for buoyancy and flotation gear (13).

A polyurethane elastomer has also been introduced on the American market under the trade name Chemigum SL. Because of its superior resistance to abrasion, this new elastomer offers the possibility of providing a tire tread for high speed service in hot climates. It also offers promise for use in heels, floor coverings, and industrial rubber products (14).

The production of isocyanates on a larger scale in this country is planned by the Mobay Chemical Co., a joint venture of Monsanto Chemical Co. and Farbenfabriken Bayer A.G. of Leverkusen, Germany (15). The semi-commercial production of ditolylene and dianisidyl diisocyanates was announced by the Carwin Co. (16). Further research on the preparation of poly-

Other Materials

Acrylics—The completion of a new plant for the production of methyl, ethyl, and ethylhexyl acrylates was announced (30). These esters are used to produce polymers for use in emulsion paints and as comonomers with styrene and vinyl esters to produce copolymers for use in adhesives and leather and textile

finishes (31). Liquid polymers of ethyl, n-butyl, and ethylhexyl acrylates serve as efficient plasticizers for polyvinyl chloride (32).

Polymethyl methacrylate continued to find outlets in plant and office glazing (33, 34), aircraft canopies (35), and housings for business machines (36). Colorants used in molding compounds and cast sheets of this material were described (37). Extrusion of strain-free, dimensionally accurate rods was accomplished (38). Research on the polymerization (39) and pyrolysis (40) of polymethyl methacrylate was reported.

The increasing importance of polyacrylonitrile as the base for a new type of synthetic fiber (Orlon) and of acrylonitrile copolymers as elastomers, resins, and fibers (Dynel, Acrilan) was shown by the growing literature on these materials (41-45). The mechanism of flocculation of aqueous suspensions of finely divided soil particles by polyacrylamides was investigated (46).

Cellulosics—Ten miles of 3-in. cellulose acetate butyrate pipe is in service transporting crude oil. The line was laid in 5 days at an installed cost 75% of that for a comparable steel pipe line (47). Extruded butyrate sheet is now available for outdoor signs; exposure tests indicate that the sheeting will withstand five years of sunshine and weathering (48). Data were presented on the heat and light stability and weathering of colorants for cellulosic plastics (49). Other noteworthy reports dealt with carboxymethylcellulose (50), cellulose acetate (51, 52), cellulose nitrate (53), cellulose ethers (54), cellulose (8, 55-57), and starch (58).

Ethylene Polymers—The first ten years of commercial production of this material in the United States has seen its principal applications develop in electrical insulation, packaging, and housewares. There are two current suppliers, with eight more companies in various stages of planning and constructing new plants (59). It has been predicted that production in 1955 will be about 500,000,000 lb., but in 1954 it was only of the order of one-third that amount.

Low molecular weight polyethylene is being used in petroleum wax mixtures to coat paper for wrapping bread (60). Cellular polyethylene extruded directly on antenna lead-in wires for television receivers has a specific gravity of 0.47 and high resistance to water penetration due to its closed pore structure (61). Films, collapsible tubes, and squeeze bottles made of polyethylene registered further gains in the packaging market (62-65). Polyethylene water piping is used for Civil Defense operations (66) and polyethylene tape is wound automatically around metal pipe lines used for natural gas transmission to protect against corrosion (67).

Thermal insulation efficiency of silicone foam is so high that one side of a slab of foam can be heated cherry red with a blow torch without making the other side too hot to touch

Procedures for preparing flanges on polyethylene pipes (68) and for locating defects in welds (69) were described. Better printing on polyethylene film has been achieved by the application of heat through the film to facilitate solvent evaporation from the ink (70). Flame-spraying of polyethylene on cement or metal provides a surface that can be decontaminated by washing with nitric acid (71). Colorants and processing operations for coloring polyethylene were specified (72). Data were presented on the mechanical properties (73), cold brittleness (74), stress cracking (75), tropical aging (76), and irradiation (3-6) of polyethylene. Research studies on chain branching and its effects on physical properties, densities, and refractive indices of polyethylene were published (77-79). Infra-red spectra and gelation reactions of chlorosulfonated polyethylene, the new elastomer first described in 1953, and some of its derivatives were recorded (80, 81).

Fluorocarbons—New facilities for the production of polymonochlorotrifluoroethylene by a continuous process began operations (82). Special mold construction utilizing hot runners permits injection of this material within the relatively narrow temperature range between plasticization and material breakdown (83). Problems involved in polymerization and characterization of molecular weight of this polymer were discussed (84-86).

The frictional properties of polyethylene and its halogenated derivatives were described in an outstanding report on this subject. Substitution of chlorine for hydrogen in polyethylene increases friction; substitution of fluorine decreases friction. The effect of chlorine was found to predominate when both fluorine and chlorine were substituted. The uniquely low coefficient of friction for polytetrafluoroethylene makes it suitable for many applications requiring dry lubricant (87).

Thermal stability (88, 89), high-temperature dielectric strength (90), and the mechanical and physical properties (91, 92) of polytetrafluoroethylene were investigated. Various aspects of the selection of coloring materials for fluorocarbons (93) and precautions required in processing these materials (94) were discussed. Application developments included electrical terminals, oil sighting windows (95), protective coatings for aluminum, and pressure-sensitive tapes (96).

Polyamides—Interest in this field during 1954 centered around caprolactam as a new base for synthetic nylons (97) and the availability of polyamides derived from soybeans by reaction of the soybean oil fatty acids with amines (98). The latter polyamides are especially useful in combination with epoxy resins to yield thermosetting materials suitable for structural adhesives, laminating, potting compositions, and protective coatings (99).

Two additional firms will in the near future be in production of caprolactam, a 6-carbon compound used to produce nylon 6. The two types of nylons most generally available at present are the 6,6, which is based on two 6-carbon compounds, namely, adipic acid and hexamethylenediamine, and the 6,10, which is made from the latter amine and

sebacic acid, a 10-carbon compound. Caprolactam is also available from several foreign sources and this has intensified experimental work on its utilization in molding compositions as well as synthetic fibers.

Parts for use in industrial equipment were molded, machined, and stamped from nylon plastic (100-103). New information was published on the chemical and physical properties of polyamides (104, 105).

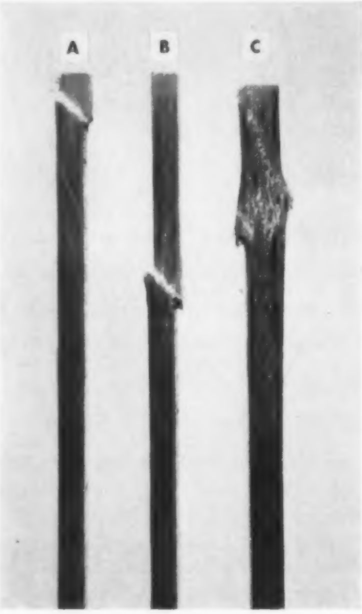
Polyesters—Commercial production of Mylar polyester film was initiated in 1954. It is based on polyethylene terephthalate, formed by the condensation of ethylene glycol and terephthalic acid. Its uses in photographic film, recording tapes, electrical insulation, decorative laminates, metallized yarns, and ropes result from its unique combination of high tensile strength and tear resistance, dimensional stability, and flexibility over the temperature range −140° to 300° F. The same polymer is used to make Dacron synthetic fiber (106-114).

The synthesis of unsaturated polyester resins of interest for casting, molding, and laminating was discussed by many authors (115-125). Pigments are needed for these resins that will be weather resistant and non-inhibitive to the cure of the polyester (126). The mechanism of degradation of alkyd resin paint films was investigated (127).

Silicones—To meet the need for a foamed-in-place resinous core material for use in the construction of supersonic aircraft and guided missiles, which develop high skin temperatures, two silicone foaming resins have been developed. These foams in a 20-lb./cu. ft. density will withstand 10 hr. at 700° F.; they have a compressive strength of 100 p.s.i. at 500° F. and 50 p.s.i. at 700° F. (128). Other developments in silicones include a fast-curing resin which yields glass-fiber laminates that resist prolonged aging at 600° F. (129, 130), pressure-sensitive adhesives for use over a wide temperature range (131), 24- by 24-in. window gaskets capable of maintaining a tight seal from −70 to 160° F. (132), and sodium methyl siliconate which can be applied as an effective water-repellent to paper, brick, cement, limestone, gypsum, and casein and alkyd coatings (133).

Styrene Polymers and Copolymers—The styrene-type resins broke into the 500,000,000 lb. production class in 1953 and appeared to be maintaining this position in 1954. Improvements continue to be directed at faster molding, higher heat resistance, and rubber-modified tougher compounds with better surface finish (134-137). Polystyrene reinforced with glass filaments has increased impact strength, dimensional stability, and heat resistance (138, 139). Polystyrene beads impregnated with a special foaming agent can be molded into special shapes for thermal insulation, flotation gear, and low-density toys and novelties (140, 141). Polymethylstyrene containing small concentrations of strongly fluorescent compounds has replaced the Geiger counter for the detection and measurement of certain types of nuclear radiation (142).

New applications for tough styrene copolymers include the body of an electrically powered wheelchair (143), the case for a chemical kit (144), and corrosion-resistant valves and pipe fittings of increased capacities (145). The properties and applications of blends of styrene-butadiene and styrene-acrylonitrile resins with rubbers were reviewed (146-150). Optimum temperatures for vacuum forming rigid styrene copolymer sheets were established (151).



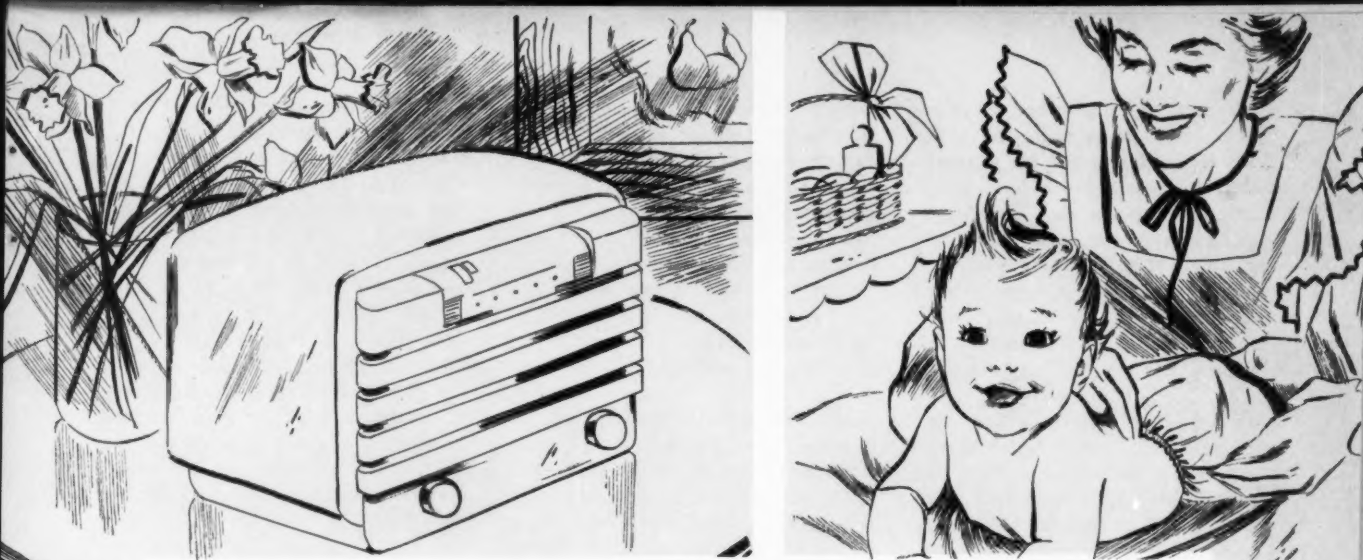
Plastic-glass laminates after failure illustrate adhesion of Epon to glass. A and B (Epon resins) fail without delamination, C (other resin) delaminates

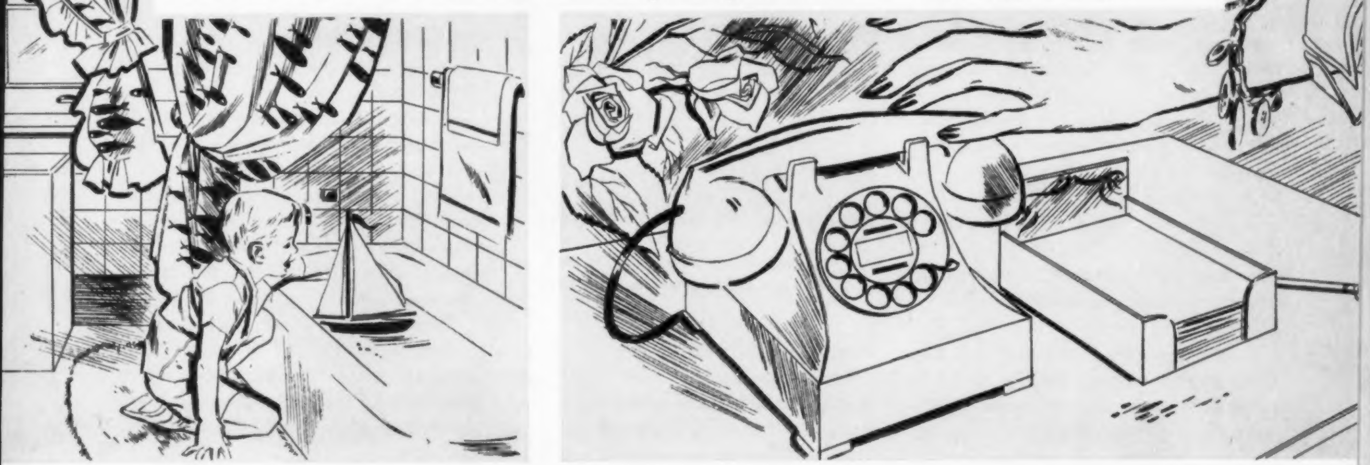
Guidelines were provided for the selection of colors for polystyrene (152) and styrene copolymer-rubber blends (153). New information on the properties of polystyrene included swelling of irradiated material (9), compression and expansion behavior (154), degradation (155), and crazing (156-158). Research investigations of the polymerization of styrene (159-162) and the molecular properties of polystyrenes (163-165) were reported.

Vinyl Polymers and Copolymers—The vinyl-type resins are also in the 500,000,000 lb. annual production class along with the styrene materials. The fabrication and use of the unplasticized (rigid) polyvinyl chloride plastic continued to receive the attention of engineers and designers (166-168). Vinyl plastisols (169, 170) were used to provide anti-corrosion coatings for chemical valves (171) and piping (172), for potting of electronic components (173), and for the production of plastic balls reported to be livelier and more durable than the conventional rubber ball (174). Other noteworthy applications of polyvinyl chloride reported were low-cost engraved printing plates for newspapers (175), porous vinyl upholstery to improve seating comfort (176), cold-water dip tubes for hot-water heaters (177), steel-reinforced extruded hose (178), sliderless zipper (179), and reconditioning of freight car interiors by glass-cloth-reinforced coatings (180).

Technical problems in manufacturing (181), compounding (182), and coloring (183) polyvinyl chloride were dealt with by experts in these fields. Approximately two-thirds of the 1953 production of plasticizers was used in polyvinyl chloride plastics; phthalate plasticizers (110,000,000 lb.) accounted for somewhat over half of the total thus used (184). Acrylonitrile-butadiene rubbers containing 30 to 37% acrylonitrile are the most commonly used elastomers for plasticizing polyvinyl chloride (185). Researches were reported on plasticizer migration (186), low temperature flexibility (187), dimensional stability (188), thermal stability (189, 190), elastic properties of gels (191), and irradiation (10) of polyvinyl chloride plastics.

Facilities have been installed to



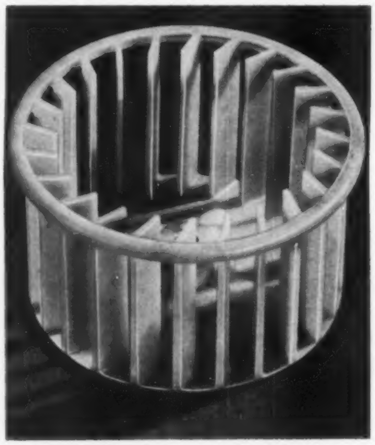


produce vinyl ethyl ether polymers which have properties that make them especially useful in pressure-sensitive adhesives (192). The production and properties of polyvinylidene chloride monofilaments (193) and films (194, 195) were described. The polymerization of certain vinyl monomers in the presence of vinyl polymers leads to the formation of a chemical bond between the resulting two polymers; polyvinyl chloride is especially active in this graft copolymerization with other monomers, such as vinyl acetate and styrene (196). Polymerization studies with vinyl acetate (197, 198), vinylpyrrolidone (199), vinylnaphthalenes, and vinylphenanthrenes (200) were reported.

Other Polymers—Industrial production and use of ion exchange resins is reported to be close to 10,000,000 lb. annually. The Los Angeles waterworks has a 50,000 cu. ft. resin installation and is planning to add another 50,000 cu. ft. (201-203). Developments in the phenolics related to increasing speed of cure (204-206), modification with epichlorohydrin to improve color, flexibility, and alkali resistance (207), blending with rubber compounds (208, 209), and elucidation of the structure and behavior of intermediate products involved in the formation of phenolic resins (210-213). Reports on the amino resins described the preparation and polymerization of melamine resins (214, 215), a new melamine glass-fiber molding compound (216), and a urea-formaldehyde-bonded woodboard (217).

New polymers recorded in the literature were poly-*p*-xylenes (218, 219), polyaminotriazoles (220), poly-bis (chloromethyl) oxabutene (221), copolymers of butadiene and cinnamyl compounds (222), and polyampholytes prepared from 2-vinylpyridine and methacrylic acid (223). Other authors dealt with rosin derivatives (224, 225), ground-nut protein fibers (226), polysulfides (227), hard rubber (228-230), elastomers (231), rubber resins for paper treatment (232), and polymerization phenomena (233-239).

Reinforced Plastics—Advances during the year in these materials were directed toward new forms of reinforcement and molding compounds. Pre-impregnated ready-to-mold sheeting was produced by bonding together thin plies of unidirectional glass filaments with epoxy resin; the sheeting contains about 60% glass fibers and is about 8 mils thick (240). Another form of reinforcement which appeared on the market is woven glass roving resembling woven rattan in appearance and providing high strength, bulk, and uniformity of distribution of the glass at relatively low cost (241). Molding compounds with glass-fiber filler became available in a wide range of resin types, including phenolic, melamine (216), silicone, styrene (138, 139), and polyester (242). The merits of various sizes and finishes for glass fibers were discussed by several authors (243-246). The selection of resins (247), the techniques required to attain color uniformity in low-pressure laminates (248), and general procedures and problems in the manufacture of reinforced plastics (249, 250) were the subjects of other articles. Properties reported on included strength at elevated temperatures (251, 252), moduli of elasticity (253, 254), dielectric breakdown (255), and strength-weight relationships (256) and bursting strength (257) of tubing.



Courtesy Owens-Corning Fiberglas Corp.
Glass-styrene fan for automobile heater does not deform under heat and load

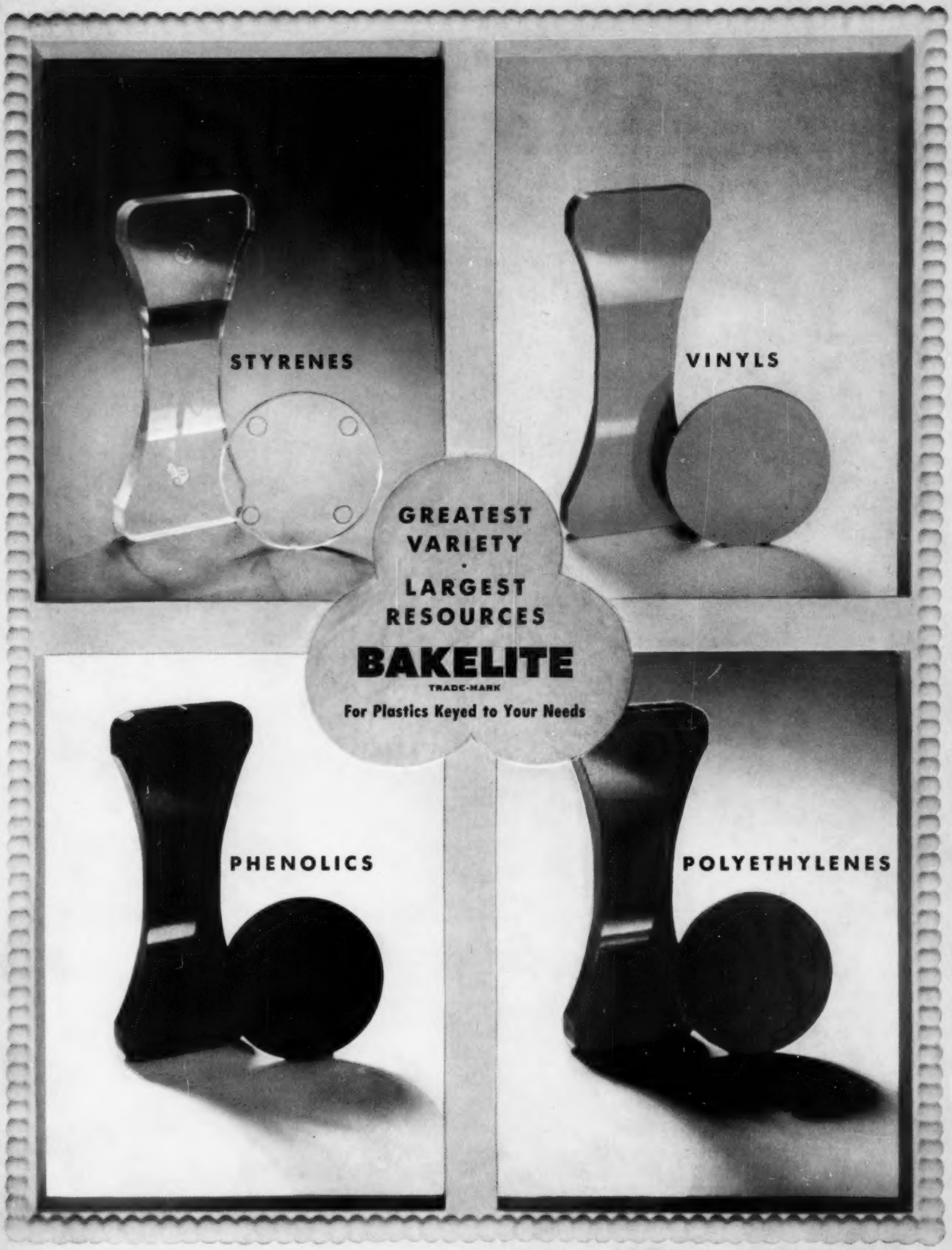
Primary activity in the applications of reinforced plastics continued to center in the building and transportation industries. Translucent structural sheeting was supplied in panels and continuous lengths for siding, porch roofing, skylighting, and store fronts (258-260). The automotive industry used reinforced plastics in the construction of cars, trailers, and buses (261-263); the same material was also popular for scooters and invalid cars (264, 265). The aircraft industry used glass-polyester materials for fuselages, structural accessories, and tooling (266-270). A 51-foot self-propelled inland barge with a 21-in. draft was built of sandwich construction with glass-polyester facings for the Army; it weighs 10.2 tons and can push a fleet of non-powered barges up to 100 tons displacement in addition to carrying 5 tons of cargo in its hold (271, 272). Other applications of this versatile material included luggage (273), artificial limbs (274), rollers for coal mine conveyors (275), drafting cloths (276), industrial safety armor (277), helmets for pilots of supersonic aircraft (278), trays for industrial operations (279), and housings for business machines (280) and pumps (281).

Expanded Plastics—A comprehensive review (282) covers current developments in foamed plastics made of polystyrene (140, 141, 283), cellulose acetate, vinyls (284-286), phenolics (287), urea resins, isocyanates (12, 13), silicones (128, 288), polyethylene (61), and a copolymer of butadiene, styrene, and acrylonitrile. These materials are making significant strides as thermal insulation in refrigeration, air-conditioning equipment, building construction, chemical storage tanks, and as a low-density material for sandwich construction, cushioning, and manufacture of novelties (289, 290).

Sandwich materials utilizing high-strength reinforced plastic facings and low-density cores have developed into a type of engineering construction that has found many important applications in aircraft structures, boat building, home construction, packaging, and radomes (291, 292). Special techniques have been worked out for the fabrication of the three major types of honeycomb core—resin-impregnated glass fabric, phenolic-impregnated cotton fabric, and resin-bonded aluminum (293, 294).

Plasticizers and Colorants—Production of plasticizers in the United States in 1953 was 293,000,000 pounds, a 10% increase over 1952. Phthalate plasticizers accounted for over half of this total (165,000,000

(*To page* 137)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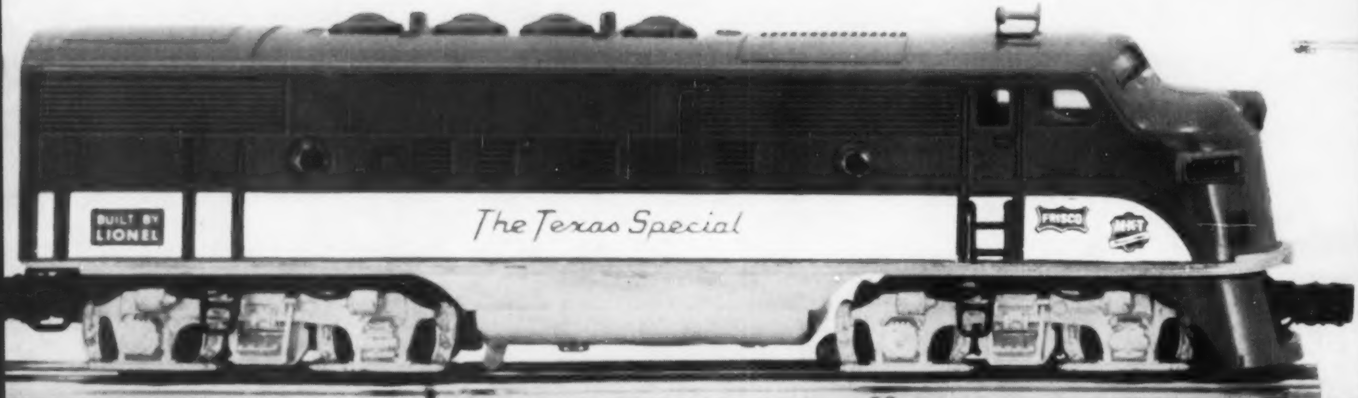

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lb.). Among the new plasticizers that have become available are alkyl aryl phosphates (295), aromatic sulfonamides (296), and epoxy fatty acid esters (297). Plasticization of polyvinyl chloride (184) and plasticizers made of acrylate esters (32) were described.

The relationships of color chemistry, color engineering, and color in marketing to the selection and use of colorants in plastics were reviewed in a symposium in print (298-301). Problems pertinent to the individual types of plastics were considered in chapters on acrylics (37), styrene polymers (152), polyethylene (72), vinyls (183), resin-rubber plastics (148), cellulosics (49), fluorocarbons (93), and polyesters (126, 248).

Processing

Vacuum Forming—Dominant feature at the Sixth National Plastics Exposition in Cleveland in June 1954 was the demonstration of vacuum forming machines. Four major end-use categories received prominence in the exhibits of vacuum-formed parts—signs and displays, packages, toys and novelties, and industrial components. This method of forming thermoplastic sheets has the advantages of low cost tooling, flexibility in design, early production, and applicability to large-area pieces. A published chart of the sources and sizes of sheets available for vacuum forming included styrene polymers and copolymers, cellulose acetate, cellulose acetate butyrate, acrylics, polyvinyl chloride, and vinyl copolymers (302). The relative merits of drape forming over a male mold and die-box forming in a female mold were discussed (303). Many reviews of vacuum-forming equipment, methods, and applications were published (151, 304-310).

Molds and Molding—The construction of molds received the attention of experts in articles on large compression molds (311-313), beryllium-copper cavities (314), sprayed metal molds (315), and balanced gating of injection molds (316, 317). Radioactive tracers were used to study the erosion of transfer molds (318). Coiled wire inserts were recommended to provide more durable screw threads in molded plastics (319).

There have been numerous improvements recently in automatic high-speed injection molding (320, 321), including jet loading of the plastic into the injection chamber (322) and the elimination of runners and sprues by multiple nozzles (323). Pressure effects (324, 325) and thermal degradation of polymers (326) during molding were studied.

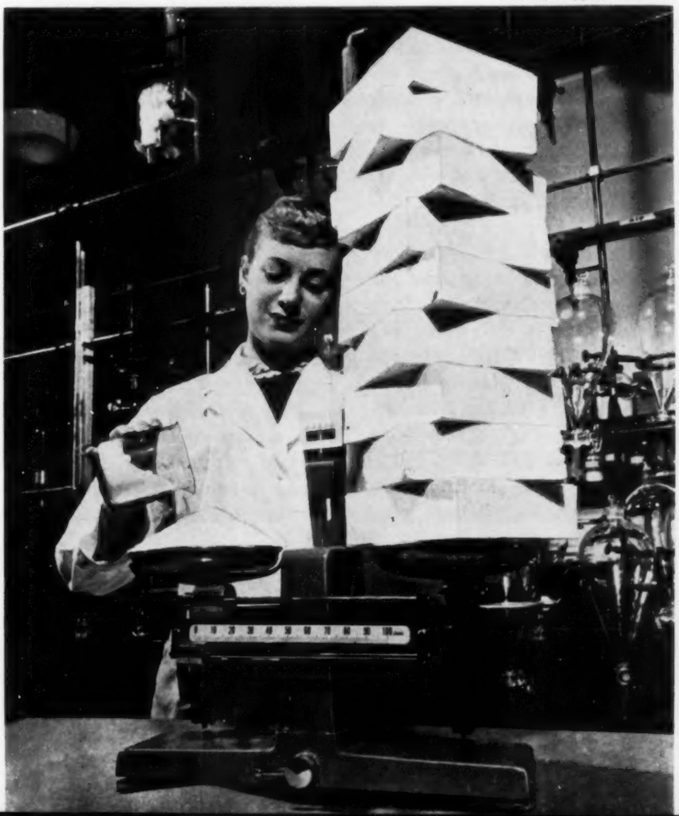
Trends in the development of extrusion machines and dies were discussed by various authors (327-335). A mobile pipe extrusion plant installed in a trailer truck can be transported by road or air to manufacture pipe at the point of use; it will process 75 to 100 lb. of material per hour into pipe up to 6 in. internal diameter (336). Precise control of temperature in four zones of the extruder cylinder, two zones of the die, and the cooling bath has made it possible to extrude acrylic rod that is dimensionally accurate and strain free (38). The rapid growth of extrusion molding is attributable to the demands for thermoplastic sheet stock for vacuum forming and the growth of the packaging film market, particularly polyethylene and plasticized polyvinyl chloride films (337).

Casting—The combination of flexible vinyl molds and rigid polyester, phenolic, or epoxy casting resins provides the product designer with an inexpensive means of preparing prototypes for evaluating consumer reaction; several techniques for preparing such models were reported (338-340). Automatic conveyorized equipment is used to embed electronic equipment in epoxy and polyester resins (341, 342). Continuous dip-molding of vinyl plastisol articles is conducted on a production line consisting of a preheating oven, dip tank, drip box, curing oven, and cooling bath (343).

Fabricating and Finishing—Metallized plastics sheets have become available in cellulose acetate, cellulose acetate butyrate, polystyrene, polyethylene terephthalate, and rigid polyvinyl chloride to meet various specialized markets. Over one million model airplanes made of metallized butyrate have been sold. Vacuum metallization is the method employed by the three leading producers of metallized plastics (344, 345). Many factors must be considered in the design and finishing of thermoplastics to produce satisfactory decorated parts (346).

Developments in accessory equipment for the molding plant were described (347, 348). Useful pointers were given for dealing with dust particles in the fabrication of glass-fiber reinforced plastics (349), liquid heating of processing equipment

Large stack of blocks of expanded polystyrene on right side of scale weighs exactly the same as small quantity of beads of expandable polystyrene on left side of scale
Courtesy Koppers Co., Inc.



(350, 351), control of temperature distribution on calender rolls by electro-magnetic induction (352), and lubrication of molding and fabricating machinery (353).

Applications

A conference on "Plastics in Building" in October 1954, sponsored by the Building Research Advisory Board, the Manufacturing Chemists' Association, and the Society of the Plastics Industry, highlighted the progress that is being made in this field. Urgently needed are industry standards for materials and products used in building applications and revised building codes that will provide performance standards to cover plastics as well as the older conventional materials.

The do-it-yourself market is accounting for major inroads by plastics into the home for flooring, wall panelling, ceilings, kitchen and bathroom trim, and patio construction. Government statistics show that 30% of building supplies are now sold to this market. Another indication of this trend is that home owners are now doing 85% of their interior painting and 60 to 65% of exterior work; development of resin-based paints is credited with a major role in this paint-it-yourself movement (354).

New developments in reinforced plastics structural panels (258, 260, 355) and their application to achieve unusual lighting effects (259, 356-358) are attracting the attention of architects, designers, and construction engineers. Luminous ceilings providing the closest approach to perfect illumination yet devised are responsible for installations of vinyl and acrylic sheets running into millions of square feet per year (34). The new plastics research laboratory of Imperial Chemical Industries Ltd. has made use of plastic partitions, work surfaces, light diffusors, floor tile, and piping (359). Other developments in the uses of plastics in the building industry (360, 361) include molded bathtubs (362), safety windows in factories (33, 363), vinyl wall tiles (364) and flooring (365, 366), fluorescent lighting fixtures (367), and air-conditioning units (368, 369).

A comprehensive survey of the plastics pipe field provided information on sources, sizes, and working pressures of pipes and fittings made

Courtesy The M. W. Kellogg Co.

ZST (zero strength time) Tester determines apparent molecular weight of thermoplastics

of polyethylene, saran, cellulose acetate butyrate, styrene copolymers and alloys, rigid polyvinyl chloride, modified vinyls, and fluorocarbons. It is reported that 25,000,000 lb. of polyethylene pipe were used in 1953 for private water systems, coal mines, and irrigation; 4,000,000 lb. of butyrate pipe were used in oil fields and manufacturing plants. The SPI Thermoplastic Pipe Div. is continuing its work on standards, backed up by data obtained in research projects at Battelle Memorial Institute and the National Sanitation Foundation (370). Noteworthy developments reported were the injection molding of tees, elbows, junctions, and couplings in polyethylene (371, 372), pipe and hose made of polytetrafluoroethylene reinforced with a braided jacket of stainless steel to handle corrosive fluids at temperatures up to 450° F. (373), and experimental installations of glass-fabric polyester pipe on a destroyer and mine-sweeper for performance tests (374).

Aircraft and Automotive—Glass-polyester reinforced plastics continued to supply the aircraft industry with structural parts (266-269, 375) and tooling (270, 376, 377). Specialty items were a de-icing heater utilizing an epoxy resin insulator (378) and a vinyl-coated-fabric canopy cover meeting the requirements of Military Specification MIL-C-7642 (379).

A 4000-gal. capacity milk truck tank has been molded in one piece in sandwich construction, utilizing glass-polyester skins and a 2-in. thick balsa core. The tank is 27 ft. long, 58 in. high, and 18 ft. in circumference; it weighs only 7000 lb. compared to 11,000 to 14,000 lb. for steel tanks of comparable capacity (380). Reinforced plastic doors that weigh one-third as much as conventional wood-metal doors have been developed for refrigerated trucks (381). Trailer (262), truck (382, 383), and bus bodies (261), and cab interiors surfaced with vinyl coated fabrics (384) are among the many new uses made of plastics in the automotive industry (263, 385, 386).

Electrical—Printed circuits on plastics laminates are replacing wired circuits in radios, televisions, electronic computers, industrial controls, servo mechanisms, guided missiles, and home appliances. The materials and methods employed in producing these components, which are revolutionizing electronic manufacturing, were described in several outstanding reports (387-390). Research in dielectric materials (391) and the fundamentals of the physics and chemistry of electrical insulation (392) were reviewed. Developments in battery separators (393) and magnetic tapes (394) were reported.

Medical—Plastics supply the physician and surgeon with many unexpected items, such as a mechanical heart-lung (395, 396) and a life-like manikin that permits realistic first-aid training (397). Improved artificial limbs (248, 274), splints (398), and casts for fractures (399) have been developed. Other new applications of interest to the medical profession include a hearing aid utilizing transistors and parts made of seven types of plastics, which operates for a month on a 15¢ dry cell instead of requiring constant battery replacement at a monthly cost of $4.50 to $9.00, as is the case with tube type hearing aids (400); a sterilizable nylon case for diagnostic instruments (401); and safety glasses with adjustable temples made of butyrate and polyethylene (402).

Packaging—The 1954 Packaging Show was again dominated by new developments in plastics applications (403). Highlighted were new uses for polyethylene in film form for bags and covers (62-64), laminated for multi-wall bags and boxes, coatings for cellophane and paper products, and collapsible tubes (65). The Interstate Commerce Commission's specifications and regulations for

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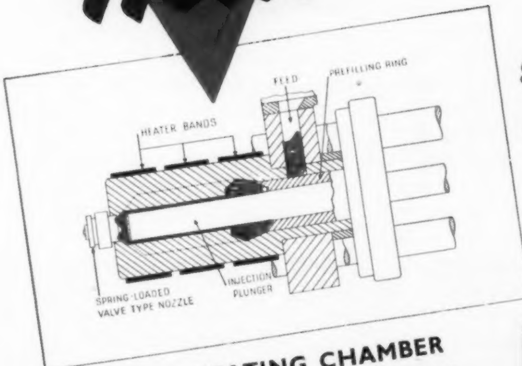

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INJECTION MOLDING MACHINE

SPECIFICATION

Approximate weight of material plasticised per hour (Dependent upon weight per shot and material used)	22 lb.
Area of Injection plunger	2.074 sq. in.
Pressure per square inch on material at end of plunger	9,100 lb.
Total pressure on Injection plunger	18,850 lb.
Mold opens (adjustable)	6—9 in.
Maximum die space	$7\frac{1}{2}$ in.
Minimum die space	$3\frac{1}{2}$ in.
Maximum recommended casting area in mold	15 sq. in.
Size of die plates	16 x 10 in.

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polyethylene carboys used to ship chemicals were reviewed (404, 405). Collapsible vinyl tubes weigh only about one-third as much as the conventional lead tubes and withstand rough handling in shipment or use (406-408). Film liners, made of polyethylene, saran, or polyvinyl chloride, for fiber or metal drums, cartons, and bags are finding increased use because they offer product protection, freedom from contamination, complete product recovery, lower container cost, and lower shipping weight (409). Results of extensive tests on the mechanical strength, low temperature flexibility, dimensional stability, permeability, and flammability of plastics films were published (410-412). Further evidence of the strides being made in the utilization of plastics in packaging was presented in reviews of the use of bottles, tubes, and vials for holding pharmaceutical preparations (413), food packaging (414, 415), molded containers (416), and vacuum-formed products (309).

Special Applications — Plastics tooling has developed into big business for many metal working companies, particularly in stamping and forming metal sheet parts for aircraft and automobiles. A glass-polyester forming die for sedan tops is 10 ft. long and weighs 12 tons; it costs one-third as much as its metal counterpart ($30,000 instead of $110,000) and is made in about one-fifth of the production time for the metal model. Phenolic, epoxy, and polyester resins are used in this application (21, 376, 377).

Business machines of many different types are made with plastics housings and parts (280, 417-420). A special vinyl-steel laminate has been developed to provide manufacturers of bank equipment with a housing material that is abrasion resistant, readily cleaned, and easily fabricated (421). Millions of scale models of airplanes, ships, cars, and the like are now molded of plastics (422, 423). Spectacular outdoor displays and signs are made of various types of plastics; one of glass-polyester is a truck model 75 ft. long (424, 425). The quality standard provided by Commercial Standard CS 173-50 is credited with an important assist in the growing consumer acceptance of melamine tableware (426, 427). Advances in synthetic fibers (428) and plastics for use as materials of construction in the chemical industry (429, 430) were reviewed. Other noteworthy developments in applications of plastics include a vinyl sheet skating rink (431), a laminated vinyl-cloth material for jackets and sportswear (432), shoe cleats (433), safety helmets (434), dry-colored polystyrene phonograph records (435), refrigerator parts (436, 437), and pneumatic tube conveyor systems (438).

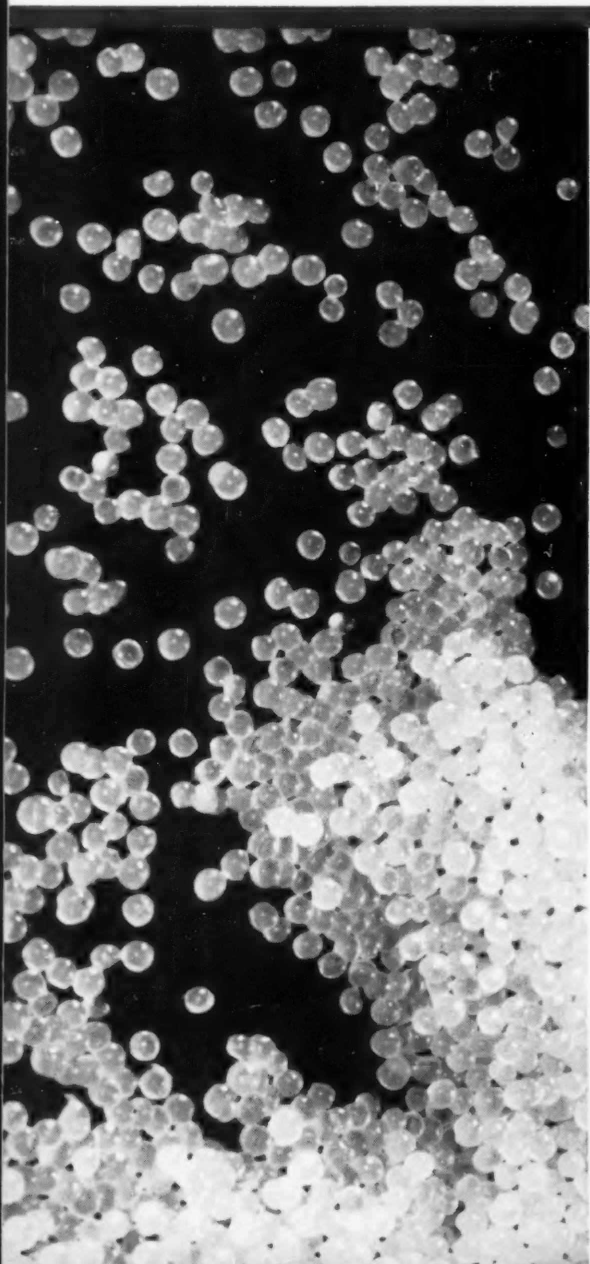
Adhesives—A metal-bonding adhesive based on phenolic and epoxy resins supported on a glass-mat base for use as a dry tape provides resistance to temperatures up to 600° F. (439-441). Problems arising in the bonding of all-glass assemblies or glass to other solids were discussed (442). Sulfited tannins were used as a base for adhesives for wood (443). Other reports dealt with measurement of gel strength of adhesives (444), mechanical testing and inspection of structural adhesives (445), investigations of the adhesive bond between surfaces (446, 447), and advances in vinyl (192) and epoxy (24) adhesives and adhesives for bonding wood (448).

Coatings—The production of synthetic resins for the protective coatings industry rose from 820,000,000 lb. in 1952 to 935,000,000 lb. in 1953. A urea-formaldehyde resin lacquer with better adhesion to cellulose acetate butyrate was achieved by the addition of a small percentage of an ion exchange resin (449). Improved properties have been built into acrylic resins for water-dispersed coating systems (450, 451). Specially formulated organic coatings for concrete and steel tanks used for storing petroleum fuels are based on vinyl resins, copolymers of vinylidene chloride and acrylonitrile, and polysulfide rubbers (452). Information on the chemistry and formulation of wash primers and interior emulsion paints was published (453, 454). Resins that can be applied by flame-spraying include polyethylene, nylon, epoxies, acrylics, shellac, and polysulfides (455). Research reports described the application of electron microscopy (456), isotopes, and chromatography (457) to the study of paints, and the measurement of chip resistance of protective coatings (458). Developments in synthetic resins in protective coatings were reviewed (23, 98, 99, 459).

High corrosion resistance and flexibility of polyethylene pipe make it particularly valuable as a replacement for metal pipe in coal mine tunnel and similar applications
Courtesy Bakelite Co.

Properties, Standards

The 1954 Nobel prize in chemistry was awarded to Dr. Linus Pauling of the California Institute of Technology for his research on the forces that hold matter together (460). An important recent contribution has been his theoretical and experimental work on the structure of fibrous proteins and synthetic polypeptides. He has developed evidence that these high polymers are made of helical chains, seven of which make up a unit. The individual chains have a left hand twist, and the unit is formed by right hand twists of six of the helical chains around a central chain. It will be recalled that last year's Nobel prize in chemistry also went to an investigator in the



field of high polymers, Dr. Hermann Staudinger of Germany.

Research reports on the physical and mechanical properties of plastics dealt with impact strength (461, 462), stiffness (463, 464), hardness (465), creep (466), flow (467), thickness (468), and strength at high temperatures (469). Extensive test results on the outdoor weathering of plastics in various climates (470), permeability to gases (471-474) and moisture (475), fungus resistance (476), and evaluation of light stability (477) were published. Factors in electrical insulator design (478), degradation of dielectrics in service (479), dielectric strength as a function of frequency (480), and arcing performance of plastics (481, 482) were discussed. A chart provides comparisons of the chemical resistance of 30 commercial plastics (483).

Analytical procedures were described for the determination of polystyrene in styrenated alkyd and epoxy resins (484); chlorine content in alkyd-modified vinyl chloride-acetate resins (485); hydroxyl groups in cellulose esters (486), polyphenolic tanninlike materials (487), and lignin (488); and free formaldehyde in phenol-formaldehyde syrups (489). Publications on methods of identification of polymeric materials embraced the acidic and alcoholic components of polyesters (490-492), wet strength resins in paper (493), and polyphenyl-butadienes (494).

Many of the papers presented at the Symposium on Macromolecules held in Stockholm and Uppsala, Sweden, in July-August 1953 at the XIIIth International Congress of Pure and Applied Chemistry were published in a special issue of the Journal of Polymer Science (495). The plenary lectures given at the same meeting included one by Linus Pauling on the structure of proteins and another by Harry F. Lewis on problems affecting the wider use of wood as a technical raw material (496).

Investigations of the molecular properties of high polymers involved the use of ultrasonics (497, 498), viscometric methods (499-501), chromatography (502), light scattering (503), ultracentrifugal sedimentation (504), precipitation fractionation (505), and fluorescence (506). Other authors reported on crystallization processes (507-509), colloidal and surface phenomena (510), and relationships between molecular weight and properties of polymers (511).

Technical Committee 61 on Plastics of the International Standardization Organization (ISO/TC 61) met at Brighton, England, in October and reached another milestone in its work by approving five test methods as Draft ISO Recommendations; in addition, five test methods, two conditioning procedures, and a glossary of equivalent terms in English and French were approved as Draft ISO Proposals (512).

Committee D-20 on Plastics of the American Society for Testing Materials adopted a method for the determination of total chlorine in vinyl chloride polymers and copolymers (D 1303-53T), made revisions in eleven of its methods and specifications, and withdrew three obsolete methods. Its work on specifications has been extended to include engineering products as well as materials; this has been implemented by the organization of subcommittees to deal with plastic pipe and fittings, reinforced plastics, and plastic film and sheeting (513). Committee D-14 on Adhesives adopted four new methods, namely, tests for adhesives relative to their use as electrical insulation (D 1304-54T), storage life by consistency and bond strength (D 1337-54T), working life of liquid or paste adhesives by consistency and bond strength (D 1338-54T), and testing cross-lap specimens for tensile properties (D 1344-54T). Three proposed methods of test were published in the annual report as information only, namely, testing bonded specimens as cantilever beams under repeated constant deflection, and susceptibility of dry adhesive films to attack by roaches and laboratory rats, respectively (514).

One-piece roof on telephone booth is molded of glass-reinforced polyester

The British Standards Institution published two British Standards relating to polyethylene tubing (515, 516). Two reviews of work on American and international standards were published (517, 518). An authority on retailing of plastics cited misapplications, insufficient thicknesses, and poor finishing as major problems and called for standards based on end uses of plastics (519).

A designer (520) and a chemist (521) discussed trends in future developments and requirements in plastics materials and products. A forum on education of plastics engineers stressed present and future needs of the industry for college trained personnel (522, 523). Industry support of a Plastics Institute was recommended to provide for the postgraduate training of technical personnel, the organization of technical information for the industry as a whole, and the exercise of leadership in a dynamic program of research and engineering studies on plastics (518).

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17. "Preparation of polymers from diisocyanates

(*To page* 208)

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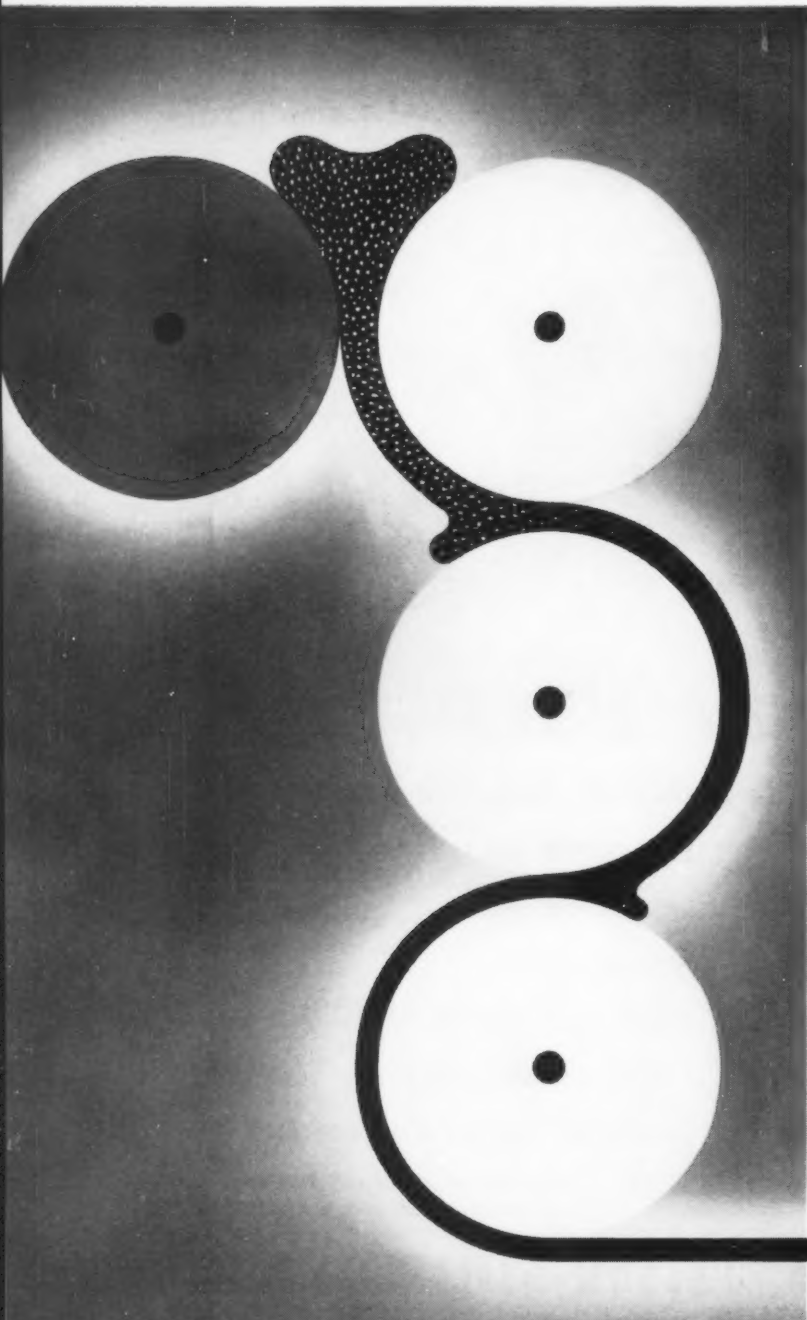

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PLASTICS DIGEST*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. Send requests for periodicals to the publishers listed.

General

DESIGN LIMITS FOR POLYESTER-GLASS LAMINATES. E. McLaud and F. Gustafson. Product Eng. *25*, 161-68 (Aug. 1954). In the design of critical load-carrying structures of glass fabric laminates, two factors of paramount importance are 1) uniformity of mechanical properties under load, and 2) allowable design limits. Test results are reported showing the effect of number of plies, contour and thickness, temperature and humidity on the mechanical properties of type of laminate. The text is supplemented with numerous graphs. The method for calculating design criteria from the test data is described. Allowable design criteria for glass fabric laminates at room temperature are given in tabular form. Graphs give allowable design criteria for elevated-temperature service by denoting allowable variations in tensile and compressive stress, tensile and compressive modulus, shear stress in tension and compression, modulus of rigidity from both tension and compression data, and interlaminar and secondary bond shear stress as functions of temperature.

REDUCED EQUATION FOR VISCOELASTIC BEHAVIOR OF AMORPHOUS POLYMERS IN THE TRANSITION REGION. A. V. Tobolsky and E. Catsiff. J.A.C.S. *76*, 4204-08 (Aug. 20, 1954). A law of corresponding states is proposed for the viscoelastic properties of amorphous polymers in the transition region. Tables are presented from which the modulus-temperature curve for many polymers can be constructed. Polymers with a low second order transition also have a narrow transition range. The proposed equation permits a relatively simple calculation of the maximum apparent heat of activation for viscoelastic behavior.

FORUM ON THE EDUCATION OF THE PLASTICS ENGINEER. C. C. Winding, R. C. Bartlett, H. A. Gadd, and J. H. Lampe. SPE J. *10*, 19-21, 68-71, 90 (June 1954). The subject is discussed in four parts: present status of education in the field of high polymers, industrial interest in the education of plastics engineers, future growth of the plastics industry, and the college view of a plastics engineer.

Materials

PROPERTIES OF IRRADIATED POLYETHYLENE. EFFECT OF INITIAL MOLECULAR WEIGHT. E. J. Lawton, J. S. Balwit and A. M. Bueche. Ind. Eng. Chem. *46*, 1703-09 (Aug. 1954). Polyethylene is cross-linked when irradiated with high-energy electrons. The physical properties of irradiated polyethylene were measured to determine the magnitude of the changes brought about by irradiation with high energy electrons and the efficiency of the electrons in the cross-linking process. Polyethylene irradiated with 800-kv. (peak) electrons was investigated over a wide temperature range. The molecular weight range covered was from 7000 to 35,000 for irradiation doses up to 200×10^6 roentgen units. The changes in tensile strength, elongation at break, and tension set were found to be dependent upon the initial molecular weight of the polymers and the total irradiation dose. A dose of 15×10^6 roentgens increased the tensile strength of a polyethylene of molecular weight 21,000 from 2100 to 3320 p.s.i., equivalent to an effective molecular weight increase of about 4000. Above the melting temperature for the unirradiated material, the irradiated polyethylene behaved as a non-crystalline cross-linked elastomer. The efficiency for cross-linking depends upon the initial molecular weight and the irradiation dose. The improvement in physical properties can be explained in terms of decreasing crystallinity and increasing cross-linking during the irradiation. The irradiation of polyethylene by high-energy electrons can be used to give a cross-linked polymer having improved physical properties and high-temperature characteristics over those of the original material.

BEATER ADDITION OF RUBBER AND RUBBER-LIKE EMULSIONS. E. C. Jahn and V. Stannett. Paper Trade J. *138*, 14-16 (Sept. 24, 1954). The addition of small quantities of rubber at the beater imparts wet strength, chemical resistance, and folding endurance to paper; the addition of large quantities of rubber yields highly flexible tear-resistant and resilient sheets for special applications. A number of different methods are described for the addition and precipitation of new emulsions that are available. Also discussed are the effect of time of contact, the effect of electrolytes, the use of cationic latices, retention and distribution determinations, the advantages of heat treatment, and the effect of beating. The rubber and rubber-like emulsions discussed include polychloroprene, styrene-butadiene and butadiene-acrylonitrile rubbers, and rubber-phenolic blends. Although different pulps respond differently to beater-added resins, no clear pattern of behavior based on type of pulp being used in the formulation is evident.

FLEXIBLE EPOXY PLASTICS. J. S. Jorczak and D. Dworkin. Prod. Eng. *25*, 154-57 (Sept. 1954). Combinations of epoxy polymers with polysulfide polymers are yielding a new class of flexible thermosetting plastics with improved mechanical and physical properties. The liquid epoxy and polysulfide polymers are mixed mechanically and cured at room temperature by the addition of an amine catalyst. The resulting epoxy-polysulfide plastics exhibit higher impact strength, a wider range of resistance to temperature cycling, lower shrinkage, less residual stress, and higher bend and peel strengths in adhesion than is obtained with unmodified epoxies. The combination retains the good dielectric characteristics and chemical resistance inherent in the parent materials. The lower viscosity of epoxy-polysulfide combinations improves resin penetration and wetting of the fibers in glass fiber laminates. The modified epoxies also

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show lower moisture absorption and vapor transmission. Chemical resistance is greatly improved; the epoxy-polysulfides are unaffected by 30 days total immersion in inorganic acids such as hydrochloric or sulfuric, in caustic soda, or in various salt solutions. The properties of epoxy-polysulfides depend on the type of epoxy, the amount of polysulfide, and the type of catalyst used in the cure.

Unsaturated Polyester Resins. Applications and Uses. A. L. Smith. Ind. Eng. Chem. *46*, 1613-15 (Aug. 1954). Although unsaturated polyesters vary in type and composition, they are generally solutions of unsaturated polyesters made from difunctional glycols and acids in a vinyl monomer. When catalyzed with a free radical catalyst, such as benzoyl peroxide, they cure by copolymerization of the vinyl monomer with the unsaturated groups in the polyester to yield a cross-linked or three-dimensional structure. The ability to cure or polymerize without evolution of volatile byproducts is their outstanding characteristic. Principal applications and uses are in laminating, casting, and molding.

Molding and Fabricating

Acrylonitrile Copolymers Blends in Pipes and Fittings. P. M. Elliott. SPE J. *10*, 26-28 (May 1954). The properties, processing, and potentialities of blends of styrene-acrylonitrile copolymer resins with butadiene-acrylonitrile copolymer rubbers for pipe and fittings are discussed. These materials have good chemical and heat resistance, and outstanding toughness. Recommendations are given for processing by extrusion. Fittings can be made readily by standard injection molding techniques and some generalizations are made about suitable molding conditions. Performance data are presented for the acrylonitrile copolymer blend pipe. This type of pipe is being used in industrial installations where resistance to alkali or acid is required, in oil fields, and numerous other installations.

Preventing Corrosion with Saran. "The Corrosion Forum," ed. by M. M. Hoover, Chem. Eng. *61*, 264, 266, 268, 270, 272 (July 1954). The composition of saran, its available forms, fabrication, and properties are discussed. Charts are used to indicate the corrosion resistance of saran to 122 different materials at various degrees of concentration over a range of various temperature conditions.

Reinforced Plastics by the DeHaviland Method. Canadian Plastics *1954*, 47-50, 52, 54 (July/Aug. 1954). A pictorial description is given of a method for producing reinforced plastic moldings through utilization of a uniquely constructed elastomeric bag that fits over the master mold to contain the wet glass-polyester lay-up while it is undergoing its curing cycle.

Extrusion Die Design. H. O. Corbett. SPE J. *10*, 15-17, 84 (June 1954). Various considerations in the selection of an extrusion machine are discussed, including type of heating system (oil or electrical) and type of machine drive. A basic die system is presented and various factors involved in the design of this system are discussed. These factors include the following components: the die base and approaching passages, adapter rings, the orifice, die land, and clamping ring.

Automatic High Speed Injection Molding. E. P. Moslo. SPE J. *10*, 12-16, 50-51 (May 1954). A fully automatic injection molding machine is made possible only by a complex coordination of three factors: electricity, hydraulics, and mechanics. The part played by each of these factors in automatic high-speed injection molding is discussed.

Applications

Automatically in Plastics. Modern Packaging *27*, 88-90 (Aug. 1954). By using an all-plastic container, the packaging of salads was mechanized, resulting in a 50% reduction in labor cost with a gain of better than 30% packaging efficiency. A polystyrene jar with a polyethylene lid replaced a less expensive waxed paper tub with a cellophane-windowed paper lid. The two keys to the new-found efficiency in production are the automatic container dispenser which is placed at the beginning of the filling line and the automatic capper which is located at the end of the mechanized packaging line.

No-Zip Zipper. Modern Packaging *27*, 91 (Aug. 1954). A new application of the vinyl sliderless zipper is on vinyl plastic pouches for eyeglass frames.

Coatings

New Acrylic Resins for Coatings. H. Grinsfelder, W. C. Prentiss, and V. N. Sheets. FPVPC Official Digest, No. 352 (May 1954). A key factor in the evolution of water-type acrylic paints has been the development of a new process for manufacturing acrylic monomers in which acetylene is reacted with carbon monoxide and an alcohol. The type of acrylic monomer obtained depends on the alcohol used. The process for manufacturing the resins is described with the aid of equations and flow sheets. The properties of acrylic resins are discussed in relation to their chemical and physical structure. The requirements and principles for formulating suitable vehicles and emulsion coatings are listed and explained. The proper amount and type of dispersant for the pigment employed is of particular importance for good stability. Good flow properties depend upon critical pigment volume. Low-boiling, water-miscible solvents are added to reduce the vapor pressure of the water sufficiently to maintain a "wet edge" during application that allows for proper coalescence of painted sections which are adjacent to each other.

Isotopic and Chromatographic Techniques Applied to Protective-Coating Technology. P. Heiberger. Paint and Varnish Production *44*, 21-27, 66 (Jan. 1954). A review of isotopic and chromatographic techniques and a guide for their use in coating technology are presented. The methods have high specificity and sensitivity. Their use is indicated when minute quantities are involved, when other methods would involve difficult separations, for non-destructive analysis, when radiation sources are required to observe fluid flow, to locate leaks, to measure film thicknesses, to disclose pinholes in coatings, to study reaction mechanisms by the use of radio-isotope tracers, and to study such phenomena as paint dispersions, efficiency of paint removers, distribution of additives in latex paints, permanency of plasticizers, effectiveness of rust preventives, and many others. The microanalysis

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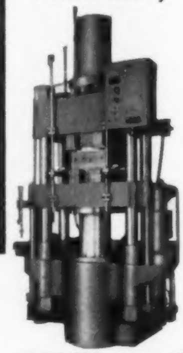

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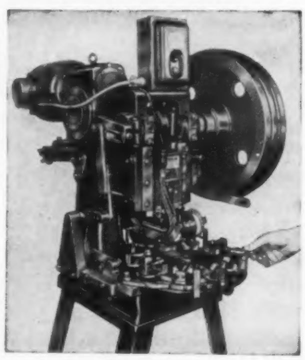

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of fatty acids can be accomplished by paper chromatography methods.

An Instrument for Measuring the Chip Resistance of Paints. E. P. Brightwell. A.S.T.M. Bulletin No. 200, 53-55 (Sept. 1954). Paints under normal service conditions are subjected to blows by sharp small objects which produce chips, causing an unsightly appearance and serious corrosion in the exposed areas. An instrument for measuring the relative chip resistance of paint systems is described.

Properties

Effect of Filler Particle Size on Resins. R. K. Witt and E. P. Cizek. Ind. Eng. Chem. *46*, 1635-39 (Aug. 1954). A study was made to determine the effects of particle size of a filler on the flexural strength of two different molding resins. Silica sand was chosen as the filler, since its shape is relatively constant over a wide size range. The resins were a melamine formaldehyde-type and an unsaturated polyester. The resin content of sample batches was varied from 5 to 30 percent. The data were examined in terms of a voids theory; consideration was given to the relation of the volume of resin present to the volume of the voids between closely packed particles of filler. Data obtained from the melamine resins were in contrast with those from the polyester mixes. In the case of the silica-melamine material, there seemed to be some correlation of particle size with flexural strength. The smaller particles of filler produced strengths that were less than those produced by coarser material. However, the opposite is true in the case of silica-polyester material because the fine sized silica produced strengths of the same magnitude as those produced by coarse silica particles when a melamine resin is used. For a given particle size there is a film thickness that produces maximum flexural strengths for silica-melamine material molded under high pressure. A maximum flexural strength occurs at about 15% melamine resin independent of the size of filler particle, although the filler size may have some effect on the maximum stress that can be developed. This result confirms to some degree the assumptions made that the predicated maximum strength should occur at about

14.8 percent. Flexural strength decreases with increasing filler particle size in the case of the polyester material. In the case of a silica-polyester resin formulation, the theoretical maximum strength should be developed at 14.1% resin, but the data indicate the maximum flexural strength at 20 to 25% resin.

Production of Fibers From 6,6-, 6,10-, and 6-Polyamides. G. Meacock. J. Appl. Chem. *4*, 172-8 (Apr. 1954). The differences in physical and chemical properties of 6,6-, 6,10-, and 6-polyamides are reflected in the conditions required for the production of the fibers, and in their properties. These factors are compared. The 6,6-polymer has the highest melting point and the least thermal stability. On the other hand, 6-polymer produces a fiber containing sufficient monomer to involve process complications and its initial modulus is low. The 6,10 fibers absorb less moisture than 6,6 or 6.

Testing

An Investigation of the Hardness Testing of Plastics. B. Maxwell. Princeton Univ. Plastics Lab. Tech. Dept. No. 34B (Aug. 18, 1954). The indentation hardness of plastics was studied in an attempt to explain some of the anomalies previously noted in these measurements, and to determine what physical constants of the material are responsible for resistance to indentation. Slow-speed Rockwell-type tests are compared to high-speed rebound type tests. These results are interpreted in terms of the rheological properties of high polymers; specifically the elastic modulus, yield point, plastic flow, elastic recovery and delayed elastic recovery. The time and temperature dependency of the response of the material to hardness measurements is demonstrated. This investigation leads to the conclusion that each type of test gives some important data but the values obtained or the relative ratings of materials shown by such tests, should be used only after careful analysis of the test data from the point of view of the correlation of the test method with the conditions under which the materials in question will be applied.

Gas-Transmission Measurement. B. E. Ellickson, V. Hasenzahl, and R. V. Hussong. Modern Packaging *27*, 173-75 (July 1954). A method

for measuring the gas permeability of films is described. The film under test is wrapped around an acrylic form with holes in all sides and heat sealed. The film can be wrapped in a chamber with a given gas and placed in a container with air to study the passage of gas from the inside to the outside, or wrapped in air and placed in a container with a given gas to measure the reverse direction of gas flow. In the latter case, the gas is allowed to flow through the container for 1 hr. after sealing the form inside. The percentage of test gas inside and outside the wrapped form is determined at the beginning of the experiment and after 96 hr., from which the gas permeability is calculated. Gas from the plastic form is analyzed in an Orsat gas analyzer and small gas samples from the container are analyzed with the Pitts monometric gas analyzer. Using this test, three films were found to be impermeable to oxygen and carbon dioxide: cellophane laminated to 0.00035-in.; aluminum foil laminated to cellophane with a wax coating on the cellophane; 150-gage saran with a wax coating; and 75 gage saran laminated to cellophane with a wax coating on the cellophane side of the laminates.

Chemistry

THE ROLE OF FREE RADICALS IN THE DEGRADATION OF HIGH POLYMERS BY ULTRASONICS AND BY HIGH-SPEED STIRRING. P. Alexander and M. Fox. J. Polymer Sci. *12*, 533-41 (Jan. 1954). The degradation of polymethacrylic acid solution by ultrasonics (250 kc.) appears to be brought about entirely by cavitation and two simultaneous reactions seem to occur. The major part of the degradation is thought to be mechanical and to be brought about by the very powerful hydrodynamic forces which are released on the collapse of the cavity and which were calculated by Rayleigh to exceed 25,000 p.s.i. About 30% of the degradation, however, can be prevented by the addition of allyl thiourea and by the removal of oxygen. Both these measures also prevent the degradation of polymethacrylic acid by X-rays, which is thought to proceed via HO_2 radicals formed by the reaction of dissolved oxygen with a primary product of radiation according to the following over-all reaction: $H_2O + O_2 \xrightarrow{\text{X-rays}} OH + HO_2$. The allyl thiourea prevents degradation by combining competitively with the HO_2 radicals formed. These experiments indicate, therefore, that HO_2 radicals are formed by ultrasonics in the presence of oxygen and the polymerization effects suggest that OH radicals are also produced. The existence of an electrical discharge during cavitation was experimentally demonstrated by Prudhomme and Bresler and had been predicted by Frenkel who calculated the potential difference between the two sides of a cavity on the basis of a statistical variation in the number of ions present. The production of free radicals would be the natural consequence of such a process. Some of the oxidation reactions of ultrasonics can probably be ascribed to the free radicals formed such as OH and HO_2. Many reactions such as the oxidation of iodide are, however, almost entirely due to H_2O_2 which is also produced by ultrasonics though in much higher concentration than the free radicals. The H_2O_2 plays no part in the degradation of polymethacrylic acid.

U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

FUSES. R. Colombo (to Lavorazione Materie Plastiche). U. S. 2,687,553, Aug. 31. Molding sheathed fuses.

MOLDING. A. A. Root (to United Shoe Machinery). U. S. 2,687,554, Aug. 31. Molding shoe treads to uppers.

CASTING. H. D. Anspon and F. E. Pschorr (to General Aniline). U. S. 2,687,555, Aug. 31. Casting alpha-chloroacrylic ester polymers.

POLYMERS. D. W. Chaney and H. M. Hoxie (to American Viscose). U. S. 2,687,938, Aug. 31. Ternary acrylonitrile polymers.

MOLDING COMPOSITION. E. J. Yedlick and E. R. Ford (to Garfield Manufacturing). U. S. 2,687,967, Aug. 31. Thermosetting inorganic molding composition.

PLASTICIZERS. J. D. Brandner and R. H. Hunter (to Atlas). U. S. 2,687,-970-1, Aug. 31. Plasticized cellulose ester compositions.

TAPE. C. W. Vogt. U. S. 2,687,978, Aug. 31. Plastic film tape.

COATING. R. Steinman (to Libbey-Owens-Ford). U. S. 2,688,006-7, Aug. 31. Composition for treating glass fibers.

POLYMERS. D. W. Chaney and H. M. Hoxie (to American Viscose). U. S. 2,688,008, Aug. 31. Mixed acrylonitrile polymers.

RESIN. W. W. Crouch and T. F. Crosnoe (to Phillips Petroleum). U. S. 2,688,009, Aug. 31. Solid reaction product of a polydiene.

POLYMERS. D. W. Chaney (to Chemstrand). U. S. 2,688,010, Aug. 31. Polymers of acrylonitrile and N-substituted amides.

POLYAMIDES. E. W. Wheatley and J. W. Fisher (to British Celanese). U. S. 2,688,011, Aug. 31. Polyamides containing a para amino benzoic acid component.

INTERPOLYMERS. D. W. Chaney and H. M. Hoxie (to American Viscose). U. S. 2,688,012, Aug. 31. Interpolymers of acrylonitrile methacrylonitrile and 2 methyl-5-vinyl pyridine.

LUBRICATING. W. Gebauer and W. A. Merck (to U. S. Rubber). U. S. 2,688,153, Sept. 7. Lubrication of plastic masses in mold machines.

EXTRUDING. G. J. Huckfeldt (to Huckfeldt and Thorlichen). U. S. 2,-688,154, Sept. 7. Extruding thin-walled tubing.

CASTING. G. F. Nadean and W. R. White (to Eastman Kodak). U. S. 2,-688,155, Sept. 7. Metering feed of plastic casting material.

MOLDING. F. Monaco, U. S. 2,688,-156, Sept. 7. Making plastic articles with a reentrant formation.

LAMINATING. J. D. Conti (to American Viscose). U. S. 2,688,356, Sept. 7. Multiple unit laminating unit.

PACKAGE. L. Peters. U. S. 2,688,-557, Sept. 7. Soft plastic food package.

COATING. E. P. Kieffer (to Polykote). U. S. 2,688,563, Sept. 7. Coating metal strip with polyethylene.

COATING. A. Arnold, H. Untergugenberger and E. Schmidt (to Wacker-Chemie). U. S. 2,688,566, Sept. 7. Coating with polyvinyl chloride.

IMPREGNATING. H. E. Malone and F. B. Rinck (to Western Electric). U. S. 2,688,569, Sept. 7. Impregnating an electrical coil.

CELLULOSE. W. M. Wooding (to American Cyanamid). U. S. 2,688,-570-1, Sept. 7. Water-resistant regenerated cellulose.

LAMINATE. P. P. Ryan and W. B. Shepardson (to St. Regis Paper). U. S. 2,688,576, Sept. 7. Electrically conductive resin laminate.

SHEET. A. T. Fisher. U. S. 2,688,-577, Sept. 7. Flock-coated thermoplastic sheet.

FLOOR COVERING. M. C. Teague (to U. S. Rubber). U. S. 2,688,578, Sept. 7. Stretchable floor covering.

HEAT TRANSFER. H. Meyer (to Lacrinoid Products). U. S. 2,688,579, Sept. 7. Heat-transferable sheet.

SHEET. S. Fingerhut (to Zenith Plastics). U. S. 2,688,580, Sept. 7. Forming glass-fiber reinforced sheet.

FOIL. H. V. G. Stubbs (to Plessey). U. S. 2,688,581, Sept. 7. Applying metal foil to plastic material.

RESINS. T. J. Suen (to American Cyanamid). U. S. 2,688,604, Sept. 7. Modified aminoplast resins.

RESINS. G. P. Schmitt and C. Werberig (to St. Regis Paper). U. S. 2,688,606, Sept. 7. Continuous production of phenolic resins.

RESINS. T. J. Suen (to American Cyanamid). U. S. 2,688,607, Sept. 7. Modified melamine resin.

COPOLYMERIZATION. H. H. Weinstock (to Allied Chemical). U. S. 2,688,608, Sept. 7. Copolymerizing acrylonitrile and acrylic esters.

HELMET. E. Marx (to B. F. McDonald). U.S. 2,688,747, Sept. 14. Protective helmet.

EXTRUSION. V. A. Rayburn (to Western Electric). U.S. 2,688,768, Sept. 14. Extruded articles.

EXTRUSION. H. Corbett (to Halco Plastics). U.S. 2,688,769, Sept. 14. Extrusion apparatus.

EXTRUSION. G. E. Henning (to Western Electric). U.S. 2,688,770, Sept. 14. Plastic temperature control in extrusion.

PLASTIC TREATMENT. P. E. Sandorft (to Lockheed). U.S. 2,688,772. Sept. 14. Treatment of materials for craze prevention.

STABILIZATION. J. W. McIntire (to Dow). U.S. 2,688,773, Sept. 14. Dimensional stabilization of films.

MOLDING. T. P. Malinowski and C. G. Trudeau (to Monsanto). U.S. 2,688,774, Sept. 14. Molding polystyrenes.

CORES. A. J. Anderson (to General Motors). U.S. 2,688,780, Sept. 14. Forming hollow sand-resin cores.

MOLDING. L. H. Zeum (to Peter Paul). U.S. 2,688,940-1, Sept. 14. Molding plastic articles.

COATING. H. Gerlich (to Badische

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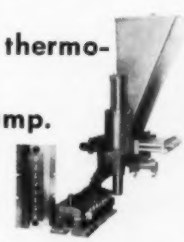

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Anilin). U.S. 2,689,197, Sept. 14. Coating polyethylene articles.

NON-WOVEN FABRIC. M. R. Pesce. U.S. 2,689,199, Sept. 14. Non-woven glass fiber-thermoplastic fiber articles.

RESINS. W. M. Thomas (to American Cyanamid). U.S. 2,689,228, Sept. 14. Polymerizates of unsaturated guanamine derivatives.

COPOLYMERS. J. F. McKenna (to Pittsburgh Plate Glass). U.S. 2,689,-231, Sept. 14. Copolymers of a drying oil, cyclopentadiene, and styrene.

COPOLYMERS. H. L. Gerhart and W. K. Hoya (to Pittsburgh Plate Glass). U.S. 2,689,232-3, Sept. 14. Copolymers of cyclic diene compounds and unsaturated compounds.

CEMENT. R. B. Seymour, R. H. Steiner, and R. Desch (to Atlas Mineral Products). U.S. 2,689,237, Sept. 14. Polyfurfuryl alcohol cement.

POLYMERS. W. M. Thomas (to American Cyanamid). U.S. 2,689,238, Sept. 14. Unsaturated guanamine polymers.

POLYMERS. S. Melamed (to Rohm and Haas). U.S. 2,689,239, Sept. 14. Methylol derivatives of polyureido-polyamides.

COPOLYMER. H. L. Gerhart (to Pittsburgh Plate Glass). U.S. 2,689,-240, Sept. 14. Copolymer of cyclopentadiene and vinyl acetate.

POLYMERIZATION. A. L. Dittman, H. J. Passino, and J. M. Wrightson (to M. W. Kellogg). U.S. 2,689,241, Sept. 14. Polymerization of fluorine-containing monomers.

POLYMERIZATION. F. J. Lucht (to Monsanto). U.S. 2,689,242, Sept. 14. Vinyl chloride polymerization.

LAMINATES. A. Goulding, Jr., J. C. Bond, H. W. Emrick, and J. W. Krosse (to Goodyear Aircraft). U.S. 2,689,372, Sept. 21. Apparatus for heating and cooling laminates.

MOLDING. G. W. Wacker. U.S. 2,-689,376, Sept. 21. Apparatus for injection molding.

EMBOSSING. J. Muth, Sr. U.S. 2,-689,378, Sept. 21. Process for embossing plastic sheet.

FILM TREATMENT. F. R. Nissel (to Carbide and Carbon). U.S. 2,689,379, Sept. 21. Producing riddled thermoplastic sheet.

BEARINGS. W. H. Tait (to Glacier Metal). U.S. 2,689,380, Sept. 21. Bearings of polytetrafluoroethylene.

BOW. L. S. Meyer (to Parallel Plastics). U.S. 2,689,559, Sept. 21. Reinforced plastic bow.

BAG. D. D. Wendt (to Bemis). U.S. 2,689,678, Sept. 21. Tubular thermoplastic bag.

PLASTICIZING. A. W. Staller (to Crescent Insulated Wire). U.S. 2,689,713, Sept. 21. Mixing plastic powder with plasticizer.

PLASTICIZERS. C. P. Albus and R. E. Field (to General Aniline). U.S. 2,689,799, Sept. 21. Cellulose esters plasticized with polyesters.

COATING. W. B. Horback and G. M. Moelter (to Celanese). U.S. 2,689,800, Sept. 21. Polyamide coating for cellulose films.

COATING. G. F. D'Alelio (to Koppers). U.S. 2,689,801, Sept. 21. Coating plastic particles.

COATING. M. W. Croze and P. L. Hedrick (to Minnesota Mining). U.S. 2,689,805, Sept. 21. Coating polytetrafluoroethylene bodies with metal.

ION EXCHANGE. J. C. H. Hwa (to Rohm and Haas). U.S. 2,689,832-3, Sept. 21. Converting weakly basic ion-exchange resins to strongly basic state.

COPOLYMERS. J. W. McNabb (to American Can and Kienle). U.S. 2,689,834, Sept. 21. Copolymers of vinyl compounds, polyphenylether alcohols, and unsaturated acids.

COPOLYMERS. H. L. Wilson and L. W. Anderson (to Standard Oil). U.S. 2,689,835, Sept. 21. Copolymer of methylpentadiene and cyclopentadiene.

PLASTICIZERS. G. Bier (to Lucius und Bruning). U.S. 2,689,836, Sept. 21. Adding plasticizers to emulsion polymerization media.

POLYMERS. J. R. Darby and E. E. Cowell (to Monsanto). U.S. 2,689,837-8, Sept. 21. Bacteria-resistant polyvinyl halide compositions.

CATALYST. R. S. Ludington (to Westinghouse). U.S. 2,689,843, Sept. 21. Boron trifluoride-piperidine curing catalyst for polysiloxane resins.

POLYMERS. S. Melamed (to Rohm and Haas). U.S. 2,689,844, Sept. 21. Methylol derivatives of polymers of ureidoalkyl vinyl ethers.

BOOKS AND BOOKLETS

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Minerals for the Chemical and Allied Industries," by Sydney J. Johnstone

Published in 1954 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 692 pages. Price: $11.50.

Substances of mineral origin are finding increasing use in the chemical and allied industries. The plastics industry in particular is becoming more and more involved in a close relationship with minerals development. The object of this book is to present in concise form essential information on the properties of minerals and metals, their sources of supply, processing and metallurgy, with particular attention to specifications for their industrial uses.

Of particular interest to the plastics industry is the treatment of mineral fillers given in various chapters of this book. It may come as a surprise, for example, to find that great quantities of marble dust are used as fillers. Chapters on antimony, borates, bentonite, feldspar, mica, phosphates, titanium, wollastonite are likely to give the reader ideas on their use with plastics or on how they enter the competitive picture. All the newer minerals such as selenium, zirconium, and columbium are treated in separate chapters.

"Die Praxis des Gummichemikers," by Paul Kluckow

Published in 1954 by Berliner Union G.m.b.H., Marienstraase 13, Stuttgart, Germany. 400 pages. Price DM 48 (ca. $11.30). In German.

This laboratory handbook is intended for those working in the rubber and synthetic rubber field. The first part deals with natural rubbers, their occurrence and their production. The second part covers synthetic rubbers, their history, their manufacture, and their properties (butadiene polymers, neoprene, polysulfides, etc.). The third part discusses additives (plasticizers, vulcanizers, colorants, etc.). The fourth part covers processing methods (mixing, vulcanizing, working with latex, etc.). Additional sections deal with rubber-like plastics. A large part of the work is devoted to test methods.

"Metals Properties," edited by Samuel L. Hoyt

Published in 1954 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 440 pages. Price: $11.00.

Sponsored by the Metals Engineering Handbook Board of the American Society of Mechanical Engineers, this reference guide gives the design engineer working data covering properties of metals with which he works. Tabulated under each of the more than 500 metals listed is such information as chemical composition; brittleness; heat treatment; industrial uses; forging, annealing, quenching, and recrystallization temperatures; etc.

"Japan Trade Directory"

Published by Japanasia Information Service, Inc., 19 Shiba Shinsakuradacho, Minatoku, Tokyo, Japan. 800 pages. Price: $8.00.

This directory contains the following classifications covering Japanese industry: An alphabetical listing of over 3700 companies, with addresses, giving information on capital, product, principal executives, founding year, etc.; and a list of firms by product. Also included is the full translated text of the Commercial Code of Japan and a summary of Japanese weights and measures and their English equivalents.

"Industrial Design," 2nd ed., by Harold Van Doren

Published in 1954 by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 380 pages. Price: $6.50.

An excellent, practical, down-to-earth primer to the field of product design and development. The book covers such topics as the designer's place in the industry, preliminary steps in product design, basic concepts and elementary techniques of design, materials and processes (including a section on plastics), and others. The business phase of the designer's profession is covered in sections on fees, relation with clients, presentation techniques, and related subjects. Profusely and functionally illustrated.

"Chemical Engineering Catalog, 1954-55"

Published in 1954 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 1951 pages. No charge in the United States and Canada if volume is returned when new edition is published. Price $3.00 for permanent purchase.

The 39th annual edition of this reference volume covering the chemical process industries presents information on equipment and raw materials, chemicals and supplies offered by over 500 participating companies, with most companies listing their entire applicable lines. Six indices provide for ready cross-reference.

"Shell Molding and Shell Mold Casting," by T. C. Du Mond

Published in 1954 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 128 pages. Price: $2.00.

Details on the shell molding process are summarized in this little volume, which offers a concise introduction to this new foundry technique. The author covers advantages and limitations of the process, cost factors, design, cores, materials, and applications.

Fatty acids—Specifications, grades, packing, and stock points on distilled stearic acid, hydrogenated tallow fatty acids, hydrogenated rubber-grade stearic acid, distilled oleic acid, distilled coconut fatty acids, distilled tallow fatty acids, distilled soya beans fatty acid, and related compounds are presented in this 24-page catalog. Information on pitch and glycerin is also included. *A. Gross & Co., 295 Madison Ave., New York 17, N. Y.*

Machinery—Two bulletins describe abrasive cut-off machines and grinding machinery, respectively. The first describes abrasive cut-off equipment which is said to handle both ferrous and non-ferrous items and to give a cut which generally requires no finishing. The grinding machinery bulletin lists horizontal spindle machines, vertical spindle machines, traveling head knife grinders, and floor grinders. Specifications and dimensions are given

for each machinery model. *Lobdell United Co., Subsidiary of United Engineering and Foundry Co., Wilmington 99, Del.*

Pumps—A complete line of Class KRV and KRVS motorpumps, with totally enclosed motors, is cataloged in Booklet 7074-D. Performance curves, cross-sections, dimensions, and descriptive information are given for each size and type of pump. Horizontal and vertical units are listed in fractional and integral hp. sizes, as are cradle- and flange-mounted units meeting JIC standards. *Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.*

Products and services—The diversified manufacturing activities of a major industrial company are described in this 50-page informational brochure. The 11 divisions of the parent company are engaged in the production of construction equipment, processing equipment, chemicals, machinery, pipe, iron and alloy iron rolls, steel castings, and numerous other items. Location and manufacturing facilities of company plants and a complete listing of available catalogs are given. *Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa.*

Instrumentation—Catalog 1 lists instrumentation equipment for process control, centralized control stations, data reduction and automation systems, chlorination equipment, and industrial glass products. Instruments described include equipment for measuring flow rate, pressure, temperature, liquid level, density, viscosity, and other variables. *Fischer & Porter Co., Hatboro, Pa.*

Product listing—"Plastics for Electronics" is the title of a folder containing a number of technical data sheets on casting resins, low-loss rod and sheet stock, high-dielectric-constant plastics, plastics foams, laminating and impregnating resins, metallized plastics, electronic embedments, and reinforced plastics laminates. *Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.*

Packaging—Step-by-step procedures in the development of a corrugated package are outlined in a booklet entitled "Creative Package Design." Sixty "tricks of the trade"—corrugated devices used by package engineers to protect merchandise in the package—are presented. *Hinde & Dauch, Sandusky, Ohio.*

Patching compound—Bulletin EP-54-19 describes an aluminum-filled epoxy resin patching compound for use on both plastics and metal structures. Application techniques are discussed. *Furane Plastics, Inc., 4516 Brazil St., Los Angeles 39, Calif.*

Extender plasticizer—Technical Bulletin O-P-153 details properties and performance characteristics of HB-20, a low-cost extender plasticizer for vinyl chloride. The compound is said to impart excellent viscosity stability to dioctyl phthalate plasticized plastisols. Because of its poor light stability, it is recommended for use only in dark-colored products. *Monsanto Chemical Co., St. Louis 4, Mo.*

Adhesive—Typical starting formulations, properties, and methods of application of liquid polymer/liquid epoxy resin adhesives are described in this 16-page booklet. These adhesives are said to have shear strength as high as 2500 p.s.i. with room temperature cure and as high as 4500 p.s.i. with elevated temperature cure. Peel strengths of up to 36 lb./in. and bond strengths of up to 227 lb./in. are also claimed. Applications include bonding of aluminum, steel, copper, tin, zinc, wood, glass, plastics, leather, rubber, and other materials. *Thiokol Chemical Corp., Trenton 7, N. J.*

Casting compounds—Technical Service Bulletin 115 describes several trial formulations and properties of cold casting compounds based on liquid polymer LP-2. Processing methods are detailed and compounding ingredient information is given. These compounds are said to be pourable and curable at room temperature to resilient rubbers with negligible shrinkage, good oil and solvent resistance, excellent low-temperature properties, and good resistance to aging and weathering. *Thiokol Corp., Trenton 7, N. J.*

Reinforced plastics—The proceedings of the Ninth Annual Technical and Management Conference of the Reinforced Plastics Division of S.P.I. contain the papers presented at the conference and the discussions following their presentation. Some of the topics covered are parting agents, finishing systems, tooling, resins, contact molding, bag molding, plunger molding, matched metal molding, continuous laminating, continuous extrusion, potting, premixing, and others. Several forums are also included. $3.00 plus postage. *The Society of the Plastics Industry, Inc., 67 W. 44th St., New York 36, N. Y.*

Melamine vs. china—Some new data on the relative merits of melamine and china dinnerware are presented in an article by W. L. Mallmann et al. in *Modern Sanitation,* entitled "Studies on the Cleaning and Sanitizing of Melamine Plastic and Vitreous China Dinnerware." Some of the conclusions are as follows: 1) No significant difference was found between the plastic and vitreous china in the number of viable organisms left after moist heat sterilization. 2) Plastic, glass, and china dishes showed similar behavior in relation to the survival of bacterial populations occurring on their surfaces. 3) As to wetting characteristics, plastic showed a somewhat greater tendency toward waterbreak, which was reduced to a practical minimum by selection of detergent and rinsing procedures. 4) Food soils are removed to the same degree. 5) On prolonged use with coffee or tea, both plastic and china are stained. 6) Under conditions prevailing in normal use, formaldehyde is not released from melamine plastic in amounts detectable by present tests methods. Reprints of the complete report are available from *The Society of the Plastics Industry, Inc., 67 W. 44th St., New York 36, N. Y.*

Valves—Bulletin 303B catalogs a series of hand and foot valves. Descriptive information, installation data, parts lists, and exploded views are included. *Ross Operating Valve Co., 120 E. Golden Gate, Detroit 3, Mich.*

Dispersion resin—Technical Release No. 14 presents data on the properties of a vinyl dispersion resin, designated QYNV, which finds application in the formulation of low-cost plastisol coatings for wire goods; paper, fabric, foil, and electrical assemblies; and the like. Information on compounding, plastisol production, and application techniques is

also given. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Lathes—Catalog T-116 presents installation, operation, and maintenance information for two recently introduced lathes, with swings of 21½ and 26 in., respectively. Wiring diagrams and a complete parts list (accompanied by exploded view illustrations for ready identification) are also included. *Cincinnati Lathe & Tool Co., Cincinnati 9, Ohio.*

Research and jobs—"The Story of Employment Opportunities" is a 34-page booklet, laid out in quasi-*Life* magazine fashion, that tells how research, especially in the chemical and plastics field, has created millions of new jobs over the last half century, and how it will function to create many new work opportunities in the years to come. *E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.*

Petroleum pipe—Technical Bulletin PL-1, first in a series, discusses the problems involved in transporting liquid petroleum products through pipe lines. These problems are analyzed from the viewpoint of requirements necessary to maintain the variables under control. The bulletin describes a typical pipe line system, the variables to be measured, and some of the problems of pipe line control. *Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa.*

Valves—Twelve basic control valve types frequently used in chemical process industries, power generating facilities, and other liquid or gas pressure control applications, are described in this four-page folder. *Atlas Valve Co., 280 South St., Newark 5, N. J.*

Nitrogen petrochemicals—Four acrylonitrile derivatives (β,β′-thiodipropionitrile; β,β′-oxydipropionitrile; β-chloropropionitrile; and β-cholopropionic acid) are described in a series of technical data sheets and are suggested for evaluation as intermediates for preservatives for fats and edible oils, synthetic lubricants, plasticizers, resins, herbicides, and similar organic chemicals. All compounds undergo the numerous reactions characteristic of the nitrile and carboxyl groups. *Monsanto Chemical Co., Organic Chemicals Div., St. Louis 1, Mo.*

Synthetic organics—The latest edition of the annually published "Physical Properties of Synthetic Organic Chemicals" presents information on more than 350 chemicals. Forty-six new products not listed in previous editions are included. The chemicals are arranged by family groups, with condensed application data for each group. Physical properties are presented in tabular form. An alphabetical cross-index is included. *Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.*

Color pastes—Price and ordering information for a range of standard color pastes for vinyl Banbury compounding are tabulated in this two-page listing. The colors are claimed to be strength controlled to permit exact duplication of tint. Matched colors are also available. *Claremont Pigment Dispersion Corp., 110 Wallabout St., Brooklyn 11, N. Y.*

Epoxy resins—Technical data and price information on a series of epoxy resin adhesives are contained in this 16-page brochure. Also included is property and price information for six clear epoxy resin formulations (without filler content). These resins are suggested for use in encapsulating, potting, impregnating, and laminating. *Armstrong Products Co., Argonne Rd., Warsaw, Ind.*

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PREMIUMS

(*From p. 97*)

CREDITS: Mule Team molds were made by Adams & Son Plastics, El Segundo, Calif. Mule mold is run on a 4-oz. Impco machine, wagon mold on a 12-oz. Lester.

Colt "metal" parts mold and Derringer molds were produced by Paragon Tool Die & Engineering Co., Los Angeles, Calif. Colt mold is run on an 8-oz. Reed-Prentice machine, Colt handle on a 4-oz. Impco, and Derringer molds on a 4-oz. Reed-Prentice.

Pepper Box mold was made by Johnson Plastic Tool Co., Southgate, Calif. It is run on a 4-oz. Impco machine.

Militia Pistol molds were made by Roy Anderson, Lynwood, Calif., and are run on 4-oz. Reed-Prentice machine.

Mule Teams molded of cellulose acetate supplied by Celanese, fire-arms molded of polystyrene supplied by Dow.

NEW MACHINERY AND EQUIPMENT

Plastics Sealer—Model 354 uses magnetic closing of a hinged pressure bar to provide clamping against side pull on the forming seal and uniform pressure from seal to seal, leaving both hands of the operator free for positioning. Standard seal length is 9 in., but longer seals are available.

Housed in a 12- by 4-in. cabinet, the sealer has a foot pedal arrangement which closes a hinged pressure bar to a ¼-in. opening, closing a limit switch and actuating an automatic cycle. The pressure bar is closed by the magnetic bar, and an adjustable automatic timer, which controls and terminates the impulse heating cycle, is actuated, releasing the finished product.

Sealing is done through a built-in buffer strip. The unit operates from a 115-v., 60-cycle source, drawing 4½ amp. of current. *Electronic Processes Corp., 1170 San Antonio Rd., Los Altos, Calif.*

Vacuum Pump—Readily movable to wherever it may be required in a plant, mobile vacuum pump unit has rubber-tired, ball bearing, swivel caster wheels. When at point of use, wheel locks are applied to keep the unit in place without sliding or slipping. Applications for the pump include vacuum and drape forming, bag molding, and other phases of production and product development. When the pump unit has been pushed into place, it is connected by a heavy-duty hose to the equipment to be used in the vacuum application. The pump wagon is then simply connected to an ordinary electrical outlet and is ready for operation.

Designated VacForm Mobile Pump Wagon, the equipment weighs 900 lb., is 3½ ft. high, and requires 4 by 2½ ft. of floor space. It has a dual-V belt drive and a 3-hp. motor. It includes an air-cooled rotary pump with automatic lubrication, a vacuum gage, a 50-gal. welded surge tank with bottom drain, exhaust filter, thermal overload protection, and an adjustable vacuum shut-off switch. The amount of vacuum is controllable, with a potential up to 29½ in. at sea level. *Vacuum Forming Corp., Port Washington, N. Y.*

Injection Machine—Model L-2-12, a 12-oz. injection molding machine, is claimed by the manufacturer to have a mold area greater than most other 16- and 20-oz. machines. The unit is reported to mold 12-oz. of polystyrene or 46.2 cu. in. of any other granular thermoplastic.

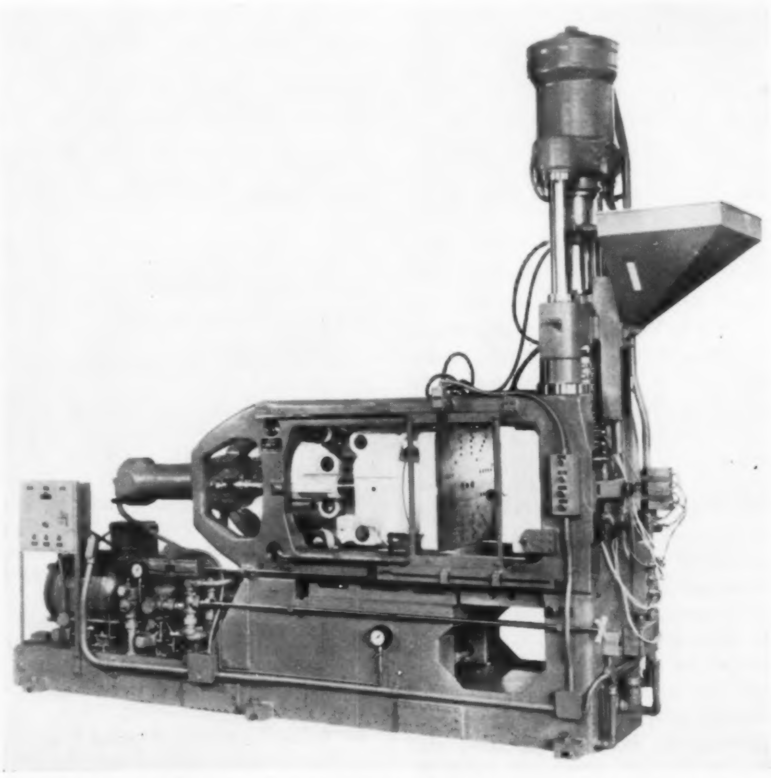
The machine has a hinged vertical injection assembly and internally heated cylinders with narrow band heaters on the outer wall and 4-zone pyrometer control. Plunger speed is adjustable. A plunger advance circuit for faster cycles and a 2-min. booster timer are included. Beam area gives 400 tons of preload clamping. Platens will accommodate 18- by 26-in. DME mold base. Mold height is adjusted by hand crank.

Linkage is double toggle in multiple shear, bolstered by a large diameter adjusting screw. *Lester-Phoenix, Inc., 2711 Church Ave., Cleveland 13, Ohio.*

Clamp Frame—Incorporation of a water cooling system as standard equipment in the mold clamp frames of a line of vacuum and drape forming machines is said to have made possible 'round-the-clock, continuous vacuum forming without overheating. The development is claimed to prevent softening and distortion of sheets clamped down for positioning and to avoid the possibility of the frame being bound or jammed by metal expansion after several hours of operation.

In addition to being supplied as standard equipment on all vacuum forming machines of the company's line now being delivered, the water-

(*To page* 166)



Lester-Phoenix's Model L-2-12 injection machine has double-toggle linkage mechanism

Plastic tooling, encapsulating, casting, sealing with ELASTOMERIC ALLOYS of *Thiokol*® LIQUID POLYMERS and LIQUID EPOXIES.

- RESILIENCE AND IMPACT STRENGTH . .
- EXCELLENT TEMPERATURE CYCLING . .
- LOWER SHRINKAGE . . . .
- ROOM TEMPERATURE CURES . . .
- IMPROVED WORKING PROPERTIES . .

These are the key properties of elastomeric alloys of "Thiokol" liquid polymer with liquid epoxies. By simple variation of the ratio of "Thiokol" liquid polymer to epoxy resin, a wide range of properties can be easily developed.

These properties meet the requirements for many applications in plastic tooling, encapsulating, casting and sealing. The basic advantages of the epoxy resins, such as high strength, chemical resistance, good electrical characteristics and excellent adhesion, are retained . . . while many other additional properties of equal importance are incorporated.

As illustrated, the versatility of these combinations is such that they are used for embedding teeth in textile combs . . . for durable potentiometer components . . . and for encapsulating electronic and electrical components. Plastic tooling and sealing are other fields where these materials meet exacting processing and performance requirements.

For complete information on the potentialities and properties of elastomeric "Thiokol" liquid polymer/epoxy resin alloys, write:

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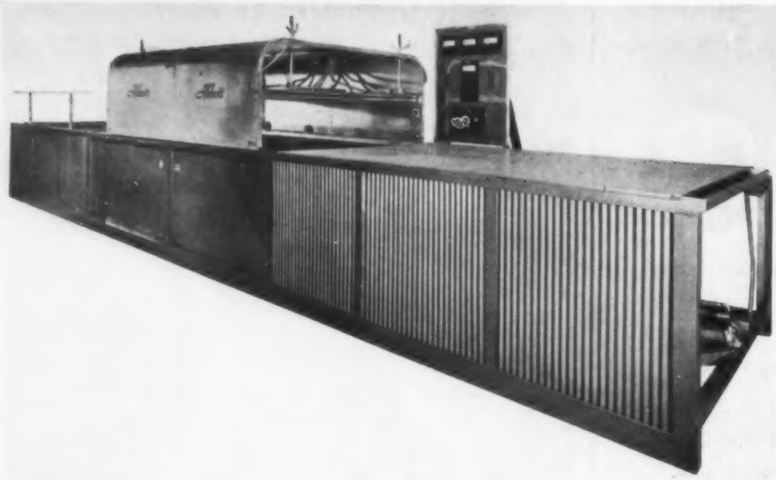
Dominion Rubber Company, Elmira, Ontario



Abbott Plastic's vacuum and drape forming machines have a working table at each end

cooling arrangement can be added to most existing machines in that line. It is not, however, suitable for other makes of vacuum forming machines without major modifications in their frame assembly. *Vacuum Forming Corp., 76 S. Bayles Ave., Port Washington, N. Y.*

Color Matching Aid—Of one-piece, enclosed booth construction, industrial daylight lamp is for use in basic industrial color matching. Dimensions of the unit are 50¼ in. high, 33⅝ in. wide, and 19⅛ in. deep. The lamp comes equipped with filters, diffusing glass, voltmeter, blower, motor, and operating control. *Macbeth Corp., P. O. Box 950, Newburgh, N. Y.*

Strain Instrument—For use with Olsen Model 51 electronic recorder, the R-40 extensometer measures large motions on specimens undergoing tension testing. The unit has magnifications of 1, ½, and ¼ for recording motions of 10, 20, or 40 inches. Other R-type instruments for gage lengths ranging from 3 to 10 in. are also offered. *Tinius Olsen Testing Machine Co., 1250 Easton Rd., Willow Grove, Pa.*

Vacuum Forming Machines—Equipped with two working tables and one heater, this line of vacuum and drape forming machines has heating elements insulated within metal hoods which run on tracks and are manually pushed back and forth between the two ends of the machines. As soon as a Microswitch is tripped, the heating cycle begins and from that point on the operation is automatic until the mold closes and the heating unit is transferred to the other end of the track.

Four models are available, accommodating, respectively, sheets of 30- by 30-, 40- by 40-, 60- by 60-, and 60- by 90-in. size. The action interval on the 30-in. model is 8 in. and goes up to 14 in. on the 60- by 90-in. model. Vacuum capacity on the 30-in. unit is 9 cu. ft./min.; on the 40-in. machine 18 cu. ft./min.; on the 60-in. machine 52 cu. ft./min.; and on the 90-in. machine 72 cu. ft./minute. Temperature is controlled by Wheelco instruments. Two special timers operate independently of each other to control heat and vacuum cycles. Clamp mechanism is of wood. *Abbott Plastic & Machine Corp., 6322 N. Clark St., Chicago 26, Ill.*

Testing Instrument—Molecular weight of thermoplastics (important in molding plastics products because it affects their tensile strength, elongation, toughness, and aging characteristics) can be checked during fabrication by means of the ZST (zero strength time) Tester. The check can be started a few minutes after a part has been produced, and its duration is said to be much shorter than that of test methods previously used (e.g. flow index, solution viscosity, no-strength temperature). Proper use of the instrument makes possible reductions in material loss and rejects, because faulty conditions can be rectified quickly.

The complete unit, operating on a 110-v., 60-cycle system, consists of an automatic temperature control furnace and components providing semi-automatic zero strength time. It is also supplied with sample holders, calibrated clip weights, cups, a thermometer, extra holders, a cutter, a notcher, and a centering device. It accommodates two samples, either individually or simultaneously. Size of tester is 10½ by 16 by 18½ in., shipping weight is 115 pounds.

In operation, notched specimens, with clip weights attached at one end, are inserted in the furnace, and timers start automatically. When the samples break, the weighted ends drop into the cups located underneath furnace openings, shutting off the recording meters. Time of break is automatically recorded.

The unit was originally engineered for use with Kel-F, but is applicable to other thermoplastics by modifying load and furnace temperature.

For a more detailed discussion, see "Determination of Apparent Molecular Weight of Polychlorotrifluoroethylene," by Herman S. Kaufman, Charles O. Kroncke, Jr., and Carmen R. Giannotta, MODERN PLASTICS *32*, 146 (Oct. 1954). The ZST tester was developed by *The M. W. Kellogg Co.*, and is commercially available from *F. J. Mullowney Co., 160 Passaic St., Trenton, N. J.*

Lathes—Two machines, swinging 21½ and 26 in., find application in the plastics industry for tool and die work. The lathes have 12 spindle speeds in geometric progression, with a 3-lever, color-match, direct-reading shift mechanism. Fifty-four thread and feed changes are made available through a totally enclosed gear box. The apron is of one-piece construction. Longitudinal and cross feeds are engaged with drop levers operating positive jaw clutches, and a spindle start-stop control lever is supplied at the apron and quick-change box. Lubrication of the carriage ways and cross-slide is provided by a one-shot plunger on the apron.

The electrical panel is fully enclosed. A built-in disconnect switch guards against exposure of the panel while "live." Lathes come with 5- or 7½-hp. motors, mounted on the rear of the headstock. *Cincinnati Lathe & Tool Co., Cincinnati 9, Ohio.*

How to build a Legend

FACT: there is no known shortcut to quality. Only painstaking workmanship, alert controls and the finest of ingredients add up to a universally accepted product.

Don't tell, but that's the trade secret of the world-famed Parker "51" pen, known wherever men are literate, sold in the world's 120 major markets. Used by kings and students, housewives and tycoons, "51" has become the world's most-wanted (and most-imitated) pen. Fine finishing touch to this remarkable writing tool is its barrel made from "Perspex" acrylic sheet.

'PERSPEX' was chosen as a "51" plastic by Parker because it is tough and attractive. It is light-fast and unaffected by climatic conditions. *'Perspex'* is easy to work with and has excellent dimensional stability. Most certainly it can help build quality into your product too.

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IMPERIAL CHEMICAL INDUSTRIES LIMITED

Plastics Division, Black Fan Road, Welwyn Garden City, Herts., England.

U.S.A. enquiries to: J. B. Henriques Inc., 521 *Fifth Av., New York* 17, *N.Y.*

OP.4

Production of

FOR the purpose of this report, production is the sum of the quantities of materials produced for consumption in the producing plant for transfer to other plants

PLASTICS AND SYNTHETIC RESIN PRODUCTION
From Statistics Compiled

Materials	*Total p'd'n. first 9 mos. 1954*	*Total sales first 9 mos. 1954*
CELLULOSE PLASTICS:[a]		
Cellulose acetate and mixed ester		
Sheets, under 0.003 gage	13,161,953	13,117,723
Sheets, 0.003 gage and over	8,647,798	9,267,687
All other sheets, rods, tubes	4,191,557	3,860,776
Molding, extrusion materials	55,222,782	53,952,681
Nitrocellulose sheets, rods, tubes	4,289,138	3,817,942
Other cellulose plastics	4,185,778	3,724,589
PHENOLIC AND OTHER TAR-ACID RESINS:		
Molding materials[a]	133,288,306	123,281,841
Bonding and adhesive resins for:		
Laminating (except plywood)	47,059,528	32,337,900
Coated and bonded abrasives	7,086,244	7,750,823
Friction materials (brake linings, clutch facings, etc.)	11,032,998	10,711,742
Thermal insulation (fiber glass, rock wool)	25,448,897	26,392,562
Plywood	20,518,370	19,827,608
All other bonding and adhesive uses	9,794,000	9,939,067
Protective-coating resins	17,726,867	16,310,245
Resins for all other uses	19,906,572	17,331,877
UREA AND MELAMINE RESINS:		
Textile-treating and textile-coating resins	26,080,084	23,013,281
Paper-treating and paper-coating resins	14,175,327	13,644,503
Bonding and adhesive resins for:		
Plywood	56,417,237	52,727,138
All other bonding and adhesive uses, including laminating	17,121,233	16,557,053
Protective-coating resins	20,261,900	15,371,169
Resins for all other uses, including molding	48,686,468	46,571,616
STYRENE RESINS:		
Molding materials[a]	235,132,845	226,620,900
Protective-coating resins	64,783,619	60,623,544
Resins for all other uses	68,859,779	64,621,216
VINYL RESINS, total[b]	371,354,404	374,978,104
Polyvinyl chloride and copolymer resins (50 percent or more polyvinyl chloride) for:		
Film (resin content)		51,576,704
Sheeting (resin content)		43,545,766
Molding and extrusion (resin content)		104,607,975
Textile and paper treating and coating (resin content)[c]		36,571,061
Flooring (resin content)		23,301,879
Protective coatings (resin content)		17,280,750
All other uses (resin content)		24,011,058
All other vinyl resins for:		
Adhesives (resin content)		20,744,490
All other uses (resin content)		53,085,759
COUMARONE-INDENE AND PETROLEUM POLYMER RESINS	138,021,823	148,865,543
MISCELLANEOUS:		
Molding materials[a, d]	138,032,876	133,045,395
Protective-coating resins[e]	5,499,074	2,854,612
Resins for all other uses[f]	89,379,874	91,862,281

* Dry basis designated unless otherwise specified.
** Partially estimated. † Revised.
[a] Includes fillers, plasticizers, and extenders. [b] Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c] Includes

Plastics Materials

of the same company, and for sale. Sales include only the quantities involved in bona fide sales in which title passes to the purchaser.

IN POUNDS* FOR AUGUST AND SEPTEMBER 1954 by U. S. Tariff Commission

*August***		*September***	
Production	*Sales*	*Production*	*Sales*
1,423,567	1,409,289	1,774,922	1,737,388
1,082,636	1,251,157	1,053,087	1,241,892
456,236	416,497	602,123	580,384
7,133,795	6,487,904	7,839,615	7,761,198
366,199	385,028	362,489	468,479
547,995	495,594	585,904	500,231
12,768,543	14,408,361	15,686,286	15,419,927
5,633,633	4,032,318	5,408,404	3,931,281
811,449	954,683	953,296	1,025,179
1,393,804	1,294,963	1,278,538	1,352,616
3,248,087	3,380,977	3,301,138	3,385,237
1,653,848	1,548,084	3,184,656	3,011,566
976,624	975,701	1,057,792	1,059,560
1,952,168	1,795,773	2,171,490	1,789,221
2,337,735	2,358,985	2,649,176	2,243,587
2,939,021	2,841,477	2,934,280	2,772,941
1,304,618	1,685,627	1,707,000	1,992,783
6,821,559	6,643,682	7,451,773	6,984,172
1,623,334	2,018,149	2,174,110	2,528,698
2,130,719	1,749,489	2,504,523	1,977,634
5,384,655	5,735,218	5,320,985	5,417,794
25,411,595	25,939,434	30,502,264	27,142,089
8,463,336	6,661,817	6,273,822	6,155,471
6,396,899	6,036,276	6,849,588	5,951,981
†34,341,262	†48,183,329	44,388,978	45,208,807
	7,077,521		5,664,779
	4,522,252		4,340,151
	14,541,061		13,454,339
	4,258,936		3,784,238
	3,931,364		3,797,141
	2,197,558		2,241,990
	3,406,825		3,778,755
	†2,443,702		2,379,392
	5,804,110		5,768,022
19,184,076	19,768,567	20,268,386	20,615,677
15,857,618	16,220,515	16,122,965	16,901,601
377,465	279,846	419,112	324,651
10,723,498	12,411,800	11,647,086	12,397,911

data for spreader and calendering-type resins. [d] Includes data for acrylic, polyethylene, nylon, and other molding materials. [e] Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins. [f] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

Phenolics

(*From pp.* 69-74)

wasn't much the molders could do about it. And to compound the trouble, it was found that most appliance producers had big inventories when the slump in sales began.

Closures—Another old standby of the phenolic industry, closures, declined rather seriously in 1954. The urea people are claiming at least 8 million lb. of the 20 to 25 million lb. closure market. Most of the urea is used in the cosmetic field. Also, polyethylene has moved into the closure field in two ways. First, it is going into squeeze bottles where phenolic closures aren't needed. This has affected cosmetic closures in particular. Secondly, small bottles for drugs and other items, as well as small collapsible tubes, are being capped in greater volume with polyethylene. Liquor bottle closures, as well as most large-size closures, seem safely ensconced in phenolic for the time being at least.

Automobiles use only a little more than a pound of phenolic per car. The main item is the distributor head and, even here, other resins are being experimentally tried for that application. But last year's decline in automotive use was ascribed solely to a million-unit decrease in passenger car sales.

Miscellaneous Uses—The miscellaneous phenolic molding powder group includes some 3 or 4 million lb. for caster wheels and some 2 million lb. for camera parts. The latter is being partially threatened by high-impact thermoplastics. Other miscellaneous uses are in textile equipment, office equipment, buttons, toilet seats, smokers' supplies, and innumerable small items. Volume for many of them might be expected to increase in reasonable but not sensational fashion over the years.

Up and Down—It's a strange fact that almost every other year this review article ends up on the note that the phenolic business has slowed down. And in alternate years the conclusion is that "business is wonderful." The best moral that can be applied is: "In good days one must prepare for evil days." After all, the industry has shown remarkable growth since its beginning only 30 years ago, and there is reason to hope that new applications or extended markets in old ones will continue to improve the over-all volume. A leading producer, Durez, has shown confidence by building a new 60 to 70 million lb. plant in Kenton, Ohio, which will come into production early in 1955, and such confidence is undoubtedly based on more than hope.

Foundry Resins—In other facets of the phenolic industry, perhaps the most interesting is shell molding resins for foundry work. The total amount is now small and probably buried in the "all other bonding resins" classification in Table II. It is doubtful that the total of all resins, both phenolic and urea, used in both core and shell moldings, exceeded 10 or 12 million lb. in 1953 and it didn't grow much in 1954. But there are wise estimators who believe that shell molding volume alone will reach 50 million lb. within about five years.

Last year, 1954, was an exceedingly poor year in the foundry business and not a fair basis upon which to estimate progress. Core resins, both phenolic and urea, improved their position not in volume but in number of foundries which began to use them as a replacement for core oil. The core resin business has fluctuated between urea and phenolic ever since it started, but at the present time phenolic use is thought to be several times greater, even though it costs 27 or 28¢ a lb. in contrast to the 23¢ dry urea price.

Something like 20 million gal., or 140 million lb., of core oil is used annually in foundries. If just half of this business went to phenolic, the result would be a substantial boost to the phenolic industry. And core resins can be easily adopted to replace oil without making a capital investment.

But the shell mold situation has received by far the most attention and, in fact, has probably suffered from too much premature publicity. Customers of foundrymen heard so much about its possibilities that they have plagued the foundrymen with unreasonable demands which cannot yet be satisfied. Furthermore, not many foundrymen are going to change over their equipment and make a heavy investment in a system that is not yet thoroughly proved nor by any means a panacea to all their problems.

In fact, very few foundries will

convert completely to shell molding. Ford Motor Co. happens to be using it for crank shafts, cam shafts, and valves, but not for everything by any means. Most other automotive companies claim they are satisfied with forged rather than cast crank shafts and may never switch to the shell mold or casting operation for crank shafts. However, all motor companies are interested and will eventually have at least a few shell molding lines. General Motors will soon triple one of its shell molding line installations and already has at least one line in each of five different plants. International Harvester is another big company that has spent a long period of time in feeling its way toward adoption of shell molding but is still on the fence. In any case, the chief idea to emerge recently seems to be that shell molding is simply another casting method and not a replacement that will obsolete all present equipment.

A few independent foundries are also beginning to take to shell molding and their progress will be closely watched. If those independent foundries now using shell molding prove that economics and results are in favor of the system, they will have scores of imitators within a relatively short time, and sales of 50 million lb. of resin for this purpose might be reached by 1958. The jump from a present 8 or 9 million lb. would be magnificent, but for the time being, at least, a cautious attitude must be assumed until the returns are in.

Adhesives — Phenolic adhesive resins for exterior plywood took a tumble that is perhaps due to strikes and pricing problems. This market ought to get back to around 40 million lb. and stay there, or even go higher. It could be that the Government figures are low, since so many new companies have gone into the business and because of changes in reporting classifications during the last two years.

Use of binder resins in thermal insulation increased in home applications, but must have suffered somewhat in that portion which goes into refrigeration and appliance insulation. The Government figure for 1953 as shown in Table II is thought to be 4 or 5 million lb. low.

Other resins such as those used for abrasives, friction materials, etc., followed the course of those indus-

tries which used them in 1954, and nearly all of them went downward.

Laminating resin sales for the decorative part of the industry were good in 1954. It is believed that some 50 or 60% of the phenolic resin for laminates is now going into cores for decorative laminates. Just a few years ago the figure was about 20 per cent.

The first six months of 1954 for decorative laminates was about 20 per cent below the last six months of 1954. This same last six months was much better than the last six months of 1953. Deliveries were as much as six weeks behind in some of the decorative plants.

Estimators think that decorative laminates will triple in volume in five years' time. The market has broadened considerably. Until 1953, dinette sets were the largest users of laminates; that field is now taking a smaller percentage. Wall paneling, partitions, and furniture uses have gone ahead and the do-it-yourself market is bounding along like a jack rabbit.

A distribution set-up that makes laminates easy to obtain has been a leading factor in this growth. It was a difficult and costly operation to achieve such distribution, but apparently the job has been done. Producers are also being careful to see that consumers know how to use their products so that they will obtain the greatest amount of satisfaction.

While this increase in decorative laminates has been going on, the industry itself has been doing some face lifting. Several of the small firms which went in for decoratives are now among the largest, and those of the older companies which specialized in decoratives have nearly all built new plants. The birth of the new plants has resulted in high speed, high quality, low-cost operations that has been perhaps the outstanding feature of the laminating industry since the close of World War II.

The market for industrial laminates has not grown to any extent. A new item, printed circuits, has enlivened operations during the past two years and all laminators have announced a variety of improved laminates for electrical purposes, punch stock, and other end uses, but few new or expanded markets have been developed.—END

Urea Melamine

(From pp. 74-75)

vision cabinet shown at the Cleveland show. Unfortunately, it came out at just the time when television producers switched over to metal and fibreboard, as explained in the section on phenolics. But hope is not lost. Just as their brethren in the phenolic industry, the urea producers have their eye on color television sets several years hence. When color television sets come down to $500 or $600, urea cabinets may well move in. At that price, the set builder must have a good cabinet. Colored urea could well be the answer. Phenolic would be less costly at about $9.00 a cabinet in contrast to urea at $13, but the color of urea might well be worth the extra cost.

The above example shows that the urea producers want to get the material into the big housing field. At one time there was some question about their resin being suitable for large pieces because of flow problems, but that difficulty is well on the way to solution.

Another example of heavy molded pieces is toilet seats. At least one producer is on the market with a $22.00 seat that uses nine or more pounds of urea. Other plastics seats are lower in cost, but the above producer is doing a fine business in a high-quality product. The urea people never expect to take more than 10% of this market, but the example illustrates that they are after quality business.

Buttons—The button market for urea is still good since they are the most commonly used buttons on such items as underwear, pajamas, etc., but some of the button market has been lost to melamine and polyester-glass.

The closure market for urea is probably larger than generally estimated—perhaps 8 or 10 million pounds. Color is the chief contributing factor. Polyethylene is a threat to part of this market but not all of it. Cosmetic closures and containers are still ideal outlets for colored or white urea, and here again quality assures urea the top portion of the market.

An extensive campaign to capture a larger share of the wiring device market was only partially successful, but the over-all market for wiring

devices was not good in 1954. It started slipping in 1953 for no established reason; it might have been over-inventory.

Other markets for urea, most of which were slightly down in 1954, were stove and cabinet hardware, housewares, bathroom accessories, radio cabinets, clocks and miscellaneous housings, food equipment, and lighting fixtures.

Reporting System Changed—The figures for other urea and melamine classifications in Table IV are also confusing. It is probable that changes in the reporting system adopted last year resulted in errors by the reporting companies. It seems obvious that the figures on "plywood" and "all other bonding and adhesive resins" must have become intermingled. Thus, direct comparison with past years would be fruitless, although the sum of these two categories gives a good comparison between 1953 and 1954.

The reason for the drop in paper-treating resins has not been ascertained. Most companies claim they sold more for this purpose in 1954 than they did in 1953. Certainly, the use of these resins to impart wet strength to paper is going to grow.

Consumption of paper per individual in the United States is now 370 lb., but 400 lb. is not out of bounds for the near future. The greatest portion of this total is expected to develop around wet strength paper, which means that more urea and melamine will be needed. Not only do the resins improve strength, but they also aid in speeding up paper manufacture.

Textile-treating resins are down because there was a decline in the textile industry last year. But a rise is almost certain in the near future and one producer thinks use of textile resins will double in 10 years. He also thinks 1955 will be much better because the highly competitive situation in the textile industry will result in improved products, many of which will involve use of resin. The increase will come primarily in summer suitings where crease prevention is highly important; but even in winter suitings a fair amount of resin is used to provide shrink resistance. It is estimated that somewhere around 5 million lb. of melamine are used in the textile business, and that the rest of the 29 million lb. shown in Table IV is urea.—END

Cellulosics

(*From pp. 75-76*)

posure to all kinds of weather. The producer, as well as vacuum formers who are using the sheet expect a good future for this particular product.

Another interesting progress report on butyrate came from Western Electric Co., in an announcement that 150,000 colored butyrate telephone housings were molded in 1954 and that from 500 to 600 thousand units would be molded in 1955.

Generally speaking, the leading outlets for butyrate molding material were in automobile steering wheels, knobs, and arm rests; telephones; fish net floats; and the proved applications of former years. Butyrate pipe made only small gains from a poundage viewpoint in 1954, but considerable quantities moved into petroleum, utility, and water conveying applications where the pipe is undergoing the usual long term testing that will determine its progress in the future. In addition, air conditioning ducts for automobiles are being produced in butyrate, as are also housings for individual speakers used in drive-in movies.

Film and Sheet—Acetate film and sheet in 1954 just about held its own with the previous record year of 1953, despite a long shut-down caused by a strike in a leading producer's plant.

A little over one third of the "under 3 gage" goes for packaging. That would include film for produce packaging, barrier wrap, general packaging, packaging laminates, window envelopes, ribbon, and pressure sensitive tape. Probably not more than one fifth of the "over 3 gage" is used for packaging.

The balance of the thin gage films are used in electrical work, in tapes for other than packaging purposes, and in a score of other applications.

The heavier gage sheet, mostly over 5 gage, is used for windshields on trainer planes, motorcycles, etc.; for wallets and identification cards; for optical applications, and boxes. The U. S. Army is using large quantities in the ordnance program.

The packaging show at Atlantic City in 1954 gave a good idea of how acetate is moving into new packaging fields. Shoe companies are using it to enclose display models. Mail order houses are using it to package hardware collections such as hinges and screws. One user told how he packaged a 7½¢ item in a 15¢ acetate container and increased the sale of an almost dead item by 400% in six months.

The "other cellulose plastics" category in Table V consists largely of ethyl cellulose and a small amount of methyl cellulose. Valite has practically disappeared, which accounts partially for the drop since 1951. Ethyl cellulose is used primarily for rockets, dip coats for metal parts, and phonograph records. Several molded items, mostly housings, are in ethyl cellulose, with two or three promising products that could eventually reach big volume but are still "under wraps." Ethyl cellulose is generally recognized as one of the toughest of all plastics but its cost is still a handicap to big volume use.

Nitrocellulose failed to hold to the gain it made in 1953 over 1952, but it still retains a large portion of its traditional markets such as eyeglass frames, toilet seats, piano keys, knife handles, and dice.—End

Styrene

(*From pp. 76-79*)

going to have to become more plastics-minded before it is adopted on a big scale.

Styrene-type sheet, of course, has its limitations in strength, temperature relationship to use, and cost. Also, it can be formed at a rate of only about 300 lb. an hour—mighty slow compared to steel fabrication speeds. At the present moment, it is also higher in cost than wood and fibreboard, but those materials are rising in cost and may cross a declining plastic cost in the future. And last but not least, the styrene-type sheet must soon expect competition from other plastics—rigid vinyl, for example.

Vacuum Forming—Increasing use of vacuum forming will, of course, promote the use of sheet, but the vacuum formers are not particularly partial to high-impact styrene. They will use any plastics material that fits their purpose. When more of them attach vacuum formers to extruders, they can cut costs and turn out big volume; but such an operation is limited in depth of draw and to uncomplicated molds. Furthermore, molds for vacuum forming that will withstand long runs are expensive and the continuous extrusion-vacuum forming process is by no means an inexpensive system to install.

During all the excitement for high-impact and vacuum forming last year, materials producers were busy improving their other resins. A better light-resistant polystyrene was put on the market to catch a bigger portion of the lighting fixture field. Heat-resistant materials were improved and lowered in price. Some of them will now withstand 197° F. while the distortion point for general-purpose is around 180° F. And general-purpose polystyrene formulations were markedly improved so that they can be molded faster with less noticeable weld lines, reduced strains, and lower mold pressure requirements.

Price Juggling—Toward the end of 1954 there was some price juggling that may have become general by the time that this article gets into print.

One producer reduced the price of general-purpose crystal polystyrene

from 31½ to 30½ cents. Another producer immediately reduced the price of heat-resistant material from 33¢ to the price of general-purpose material. Such price juggling may spread all along the line and, in any case, will affect the amount of general-purpose used for certain products. With higher heat-resistant material at the same price as general-purpose, the former will almost certainly be used for such things as radio cabinets, battery parts, some types of housewares and toys, and items like cameras that are subject to display for long periods of time in hot store windows.

Producers believe that there will be considerable change in the percentage figures relating to end-product use of styrene within the next few years.

Housewares, for example, are due to decline even though high-impact and higher heat-resistant materials will help to maintain a reasonable production level in such things as bread boxes and canisters. The complete plastics housewares volume is expected to grow to 90 million lb. in a few years, but polyethylene is expected to have 40 or 50% of the market by the time it has grown to those proportions.

Polystyrene in toys declined severely in 1954, as expected, but is by no means completely out of the picture. High-impact material has helped, the extra-high-impact may help more, and there is a trend toward metal-polystyrene combination that whips the "brittleness" complaint. One large plastics toy manufacturer has just recently put in a metal stamping plant for that very reason.

Wall tile sales grew only slightly in 1954 and may level off to a few million pounds increase per year. Refrigerators are now thought to average about 10 lb. of polystyrene per unit and this figure should soon grow to 12 pounds. When high-impact inner doors are adopted universally, the poundage may leap to an average of 20 pounds. Number of refrigerators produced has dropped to from 3 to 4 million since 1951, when 6 million were produced.

Packaging uses for polystyrene are expected to increase by 50% or more within a few years. Radio use will probably increase normally with population growth. Styrene-type television masks fell back recently

when other materials, including vinyl, gained part of the market. But color television may perk up the market again when more expensive sets will re-adopt plastics masks and other parts that have been superseded because of cost. Air conditioner parts, lighting fixtures, and premiums could easily increase by 100% or more in the course of the next five years.

Toilet seats, both injection and compression molded, are making unusually good progress. From a 4 million-lb. volume in 1953, they could grow to 10 million in 1958.

Some of the low-volume uses today could get big quite fast if present indications are any harbinger of the future. Phonograph records are an example. There is great difference of opinion about how much polystyrene is used for them today, but certainly the time is not far distant when they will be consuming 15 million lb. a year. Signs and displays could increase consumption by 200% within a few years time. No one is quite certain just how much increase will be created by vacuum formed signs and other sheet applications—but 50 or 60 million lb. per year in four or five years is not an unreasonable estimate. Furniture parts such as cabinet and dresser drawers of vacuum formed sheet would boost the estimate considerably if they take hold. Motor vehicles, too, may soon be using large quantities. For example, there is already a styrene copolymer sheet being used for the inner lining of automobile roof tops but there is a reported possibility that, because of cost, it may be switched to high-impact material. In addition, many of the 1955 cars will have seat side panels, leg panels, and arm rests formed of styrene copolymer sheet.

Battery parts are another interesting possibility. Today's use is less than 5 million lb., but 10 million lb. could be used if a low-cost formulation could be provided, and the prospect for such a formulation is not an unreasonable one.

Foams—Polystyrene foam uses are also expected to increase. One material has been on the market for several years and continues to show steady increase in packaging, display, and insulation applications. It is furnished in sheet or block form only.

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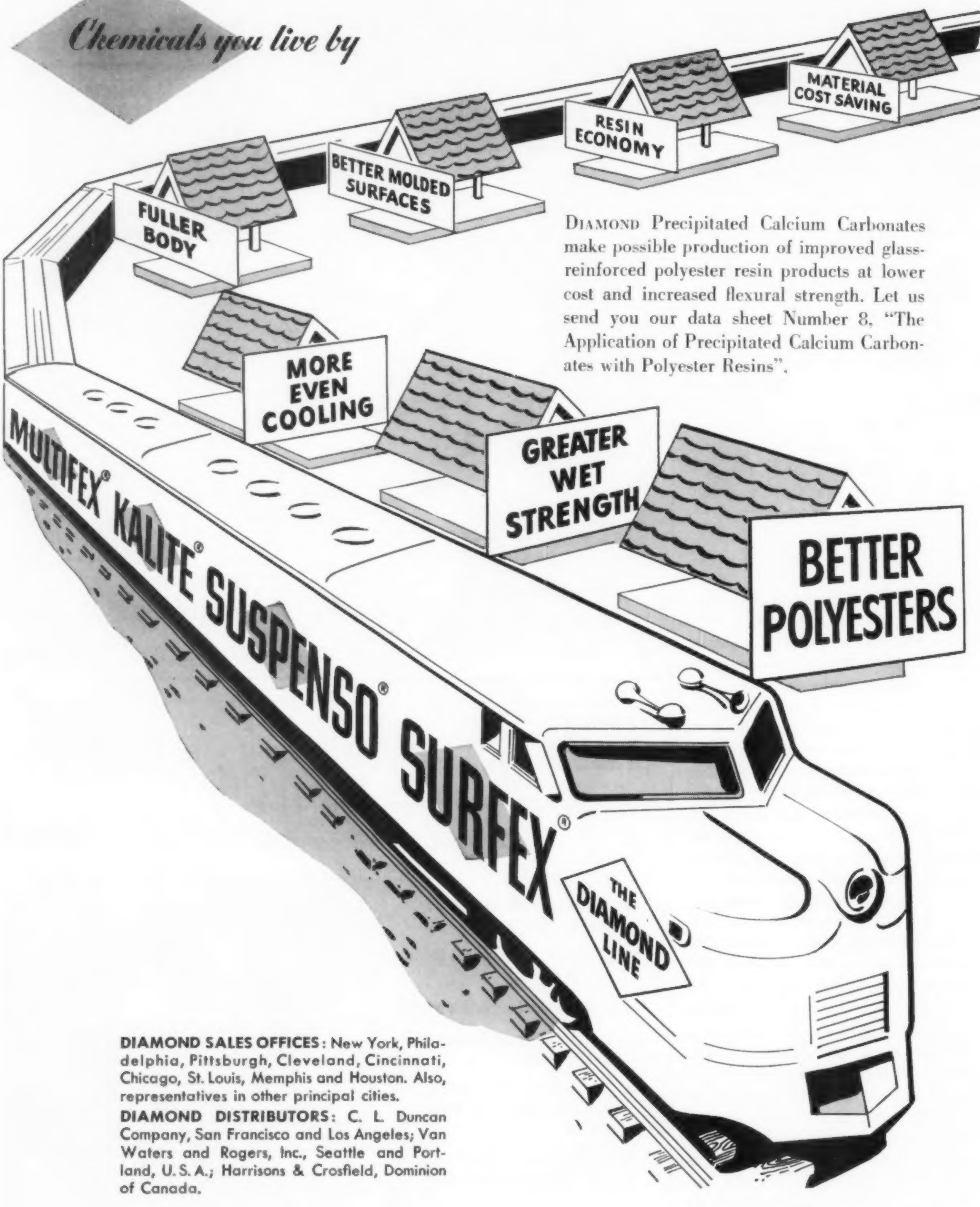

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in 1954, in the form of beads that can be foamed by the molder as needed, is still developmental. Firms like tank builders and insulation contractors are interested, but at present the greatest need is for better machines to fabricate the material. As a thermal insulator, it compares with conventional materials for low-temperature resistance and has a great advantage in that it won't "frost out." It is a bit more costly than fibrous glass or rock wool in home refrigerators, but where strength or rigidity is needed, it has superior qualities.

Molders are also interested in the foamable beads as a material for toys, or even flower pots. It may take a long time to catch on, but on the other hand it has such useful properties that it is quite possible that eventually individual customers may demand it at the rate of millions of pounds a year.

Possibilities are There—It is not too fantastic to dream of a total market for styrene-type molded plastics of 450 million lb. by 1958, provided there are no severe economic set-backs in the intervening years. Some of the above prospects will have to materialize in a big and spectacular way if that goal is reached, but the possibilities are certainly there.

Styrene resins for other purposes held about even in 1954. The sensational growth of latex for paint resins leveled off, probably because distribution channels were filled up after the mad rush by customers for latex paints set retailers in a panic. About 45 million gal. of paint using 1¾ lb. of resin per gal. were made in 1954.

In addition to this, styrene resin was used in styrenated alkyds which are probably due for a big increase, and styrene-butadiene solubles were used for numerous formulations of masonry and asbestos siding paints at a rate of approximately ¾ lb. per gallon.

"Resins for all other uses" in Table VI, p. 78, include some 20 to 25 million lb. in polyester laminating resins; a little under 30 million lb. for reinforced rubber and shoe soles; several million pounds for ion exchange resins, which are still in their infancy; and a great big unknown quantity which finds application in the production of latex used in paper coating.—END

Acrylics

(*From pp. 79-80*)

truded sheet. The material can be used in practically all applications where surface perfection is not the dominating requirement which has to be met.

Cast sheet, however, is still the big volume producer. End products haven't changed much over the last few years; airplane glazing, window glazing, signs, and lighting panels are the chief outlets. The military demand has, of course, declined, for although war planes are being built in great numbers, the demands for stock and repair parts necessary during the Korean campaign are no longer evident. The helicopter market, which may some day be astronomical, is presently small.

Late in the year, a new low-cost cast sheet was introduced to sell in 3000-sq. ft. quantities at around 72.2¢ a sq. ft. in contrast to the previous lowest cost of around 96¢ a sq. foot. This new material will obviously compete with other thermoplastics, especially for the outdoor sign market. It has slightly lower optical standards than the higher priced material but good enough to meet most any other requirement for sheet. It comes in $\frac{1}{8}$-, $\frac{3}{16}$-, and $\frac{1}{4}$-in. thicknesses and is recommended for signs, glazing, lighting and display letters, or wherever surface properties are not an important factor. It may eat into the market for extruded sheet, although the latter is seldom used in thicknesses over $\frac{1}{8}$ inch.

An interesting development in the acrylic family is a resin for paint latex that looks most promising. Complaints that it is too high priced seem unconfirmed since a mail order house is now selling an acrylic paint for \$4.79 a gal., which is in direct competition with other latex-type paints. It can be used both indoors and outdoors. Its one great advantage is lack of odor. It can be painted over old surfaces, including wood, and so far has withstood aging tests comparable with any other paint on the market today.

Similar acrylic coatings are being used as primer sealers on metal—even automobiles—on bread wrappers and cigaret cartons, and as a temporary binder material for use in ceramics.—END

Vinyl

(*From pp. 80-82*)

PLASTICS and in the Government's annual report, but the amount assigned to each classification varies. Furthermore, the Government has three sets of figures for vinyl chloride. First is the sum-up of their monthly report. This is always higher than in the Government's annual report (the second set of figures) because it includes a few intra-company transactions which, investigation indicates, are "lost" resins; that is, they never reach the status of finished goods. In 1953 the difference between the first and the second reports was 18 million pounds. The third Government figure is that listed under "chemical composition synthetic organic chemicals" in the annual report. According to that figure, there were 394 million lb. of polyvinyl chloride and copolymers sold in 1953, which is 35 million lb. over the 359 million lb. of vinyl chloride listed in the end-use classification. But that 35 million lb. is made up of resins which contain less than 50% vinyl chloride

and is never included in the vinyl chloride industry by the trade. It is included in the "all other vinyl resins," a distinctly different classification.

Flooring and Extrusions—The biggest gains in vinyl chloride resins in 1954 were made in flooring and extrusions.

Vinyl chloride flooring resin has been making big increases for two years and is expected to become as high as 70 or 75 million lb. by 1960. The poundage in vinyl asbestos flooring has grown rapidly. The resin approximates 18% of the compound, but there is considerable uncertainty about actual compound content since the flooring producers vary the amounts of resin, plasticizer, filler, and other components according to need. The plasticizers used are phosphates, phthalates, chlorinated paraffin, and extenders.

Laminated flooring is also growing. It consists of a 25- to 32-mil sheet laminated to a felt backing and is comparable in retail price with 1/16 in. thick vinyl asbestos tile as well as linoleum.

The third flooring type is called homogenous or fully resilient. It is a solid 1/8 to 1/4 in. thick material containing about 28% resin binder plus plasticizers, clay, and calcium carbonate used as fillers. It is a more expensive material used for commercial and high quality home jobs.

There is one other type of flooring, which is vinyl coated paper laminated to felt, but resin volume is comparatively small even though yardage is great. The resin is listed in Table VII under Paper Treatment.

In the molding and extrusion branch of the vinyl chloride industry, there was an increase in practically every classification. The estimated division is thought to be somewhat as follows:

Wire coating	70,000,000 lb.
Garden hose	13,000,000 lb.
Profiles	14,000,000 lb.
Molding (phonograph records, slush molding, etc.)	30,000,000 lb.
TOTAL	127,000,000 lb.

Wire Coating—Big as it is, the wire coating volume may be even larger than the total given here. This is somewhat surprising since military demands have been drastically cut

(*To page* 187)

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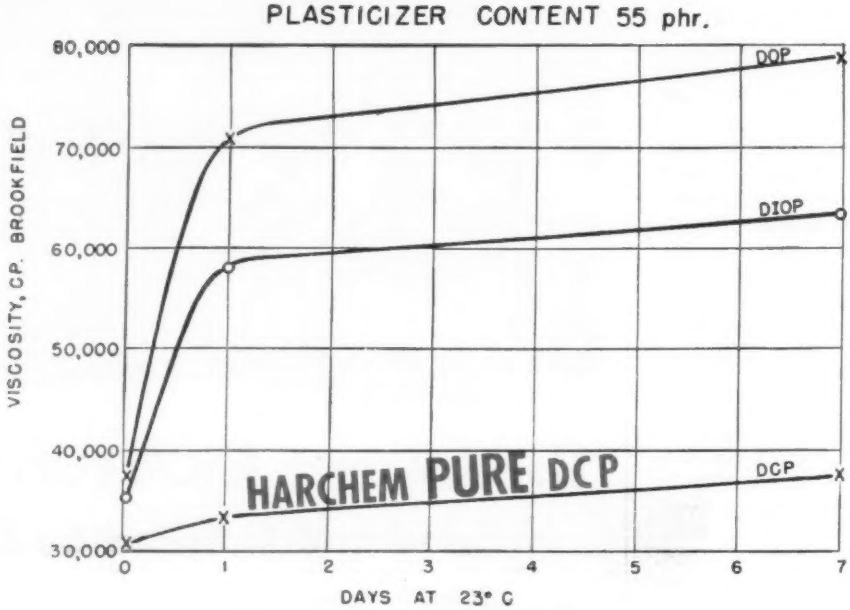

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and it was hardly expected that civilian demand could take up the slack so quickly. Biggest use for vinyl jacketing on wire is in house wire, and as long as the present nation-wide construction program is in effect, there will be continued demand. About 90% of all house wire is now covered with vinyl.

There is also in prospect a replacement program for wiring in old structures that may burst forth any day. A few disastrous fires could well start such a program for most old homes; many buildings are inadequately wired for today's loads. Vinyl-covered wire is ideal for the job since the vinyl coating can be thinner than the old-fashioned coverings and thus a larger wire carrying a larger electrical load can be used without increasing the over-all diameter.

At present there is no sign that vinyl-coated wire is ready to enter any other lucrative fields in the wiring field. Indeed, there are challenges coming from other sources in that field. Butyl rubber has come along fast as an insulating material, and although it is now used mostly for high voltage, there is some demand for it in building wire in wet locations where temperatures of 75° C. are prevalent. Vinyl producers are working on a new resin which they are confident will meet this challenge but have a wary eye on the butyl invader.

At present, vinyl covering is limited to use on wire for 600 v. or under and until more heat resistance is built into it, there is little chance of vinyl being used on power lines to replace rubber. In 1953 there were 45,000 tons of rubber used by the wire and cable industry. Vinyl is expected to move in on a large slice of that business some day because it does not have to be vulcanized, but thousands of hours of research will have to be expended before that time comes.

Extrusion—Profile extrusions are growing steadily. Window channeling and automotive welting are the leaders in this field. The latter has lots of room to grow—at present most of it is used for fender welting, but it is becoming more common for use around windows in autos where advantage may be taken of vinyl's color possibilities.

The garden hose business for vinyl went up in total poundage last year,

but no one seems certain about how much scrap went into the operation. Poundage is hard to guess because of variations in diameter, but an average of 16 ft./lb. of resin is possible. There is also confusion over total footage for all hose since everything over ½-in. diameter is labeled industrial hose. It is estimated that about 350 million ft. of garden hose was produced in 1954; at least 250 million ft. of it was thought to be vinyl. Of this amount almost 100 million ft. was transparent. The development of sprinkler or soaker hose added a marketing program that resulted in sales of about 50 million ft. more than the year before. It is difficult to foresee more than normal growth in this field. Furthermore, there may be competition from polyethylene sprinkler systems, although this impact will be felt more by rubber hose than the small diameter garden hose.

Molding includes phonograph records, slush molding of plastisols, and elastomeric moldings for such uses as luggage corners, rigid pipe fittings, and electrical parts. Slush molded dolls and toys could account for 7 or 8 million lb. of the total. This branch of the industry is growing slowly; there is not much, if any, increase in 1954 over 1953.

Fabric Coatings—Fabric treatment has been increasing steadily for several years and should continue to increase by several million lb. a year for an indefinite time. It has been estimated that calender- and spread-coating now share the coating field almost half and half, with calender coating slightly ahead. A little over 20 million lb. for each is estimated. The balance of the resin in the fabric treatment category is mostly vinyl latex used for binding nonwoven fabric and as a prime coat that is used on fabric before applying the finishing layers. Calender-coated fabric is seldom treated with a prime coat.

The increase of coated fabric is due partly to its growing use in automobiles. About 75% of calendered coating and some spread-coated material goes to automotive uses. Some 5 to 8 oz. of resin is used per yard of calender-coated goods; from 1 to 5 oz. is used for spread-coating, although there is a wide variation, depending upon the pattern. One sample of well-known coated upholstery measures 48 mils in thickness from the bottom of the fabric to the top.

Spread-coated fabric is finding ever increasing markets in the furniture field. Plastisols or organosols are generally used for this purpose. Better styling is generally given credit for customer acceptance in this field. Since producers have developed their own patterns and ideas instead of copying from other materials, their progress has been more rapid. Use of a knitted cotton backing that permits a certain amount of elasticity also helped. Prospects that unwoven fabric or knitted rayon backing might move into the field have not yet materialized.

There is some possibility that coated fabric may eventually move into the wall covering field in big volume. One processor has a material selling at $1.00 per sq. yd. that seems practical and economical. Then there is also the more expensive, heavier coated material selling from $2.50 to $10.00 per yd. that is used to some extent in night clubs and offices. Products like this grow slowly, but they certainly attract attention.

Still another development in

coated fabric is a sheet of film laminated to fabric. The film may be reverse printed and laminated to the fabric with the printed side next to the fabric. The printed design cannot wear off and the pattern is limited only by the ingenuity of the designer. This development looks like one of the most promising yet developed in the vinyl-and-fabric field.

Vinyl outerwear jackets, overlapping the fabric coating, film, and sheeting classifications, were a minor sensation last year. They came in various fashions—calender- and spread-coated, film laminated to fabric, sheeting, and even in straight film 4 or 6 mils thick. Somewhere around 7 or 8 million lb. of resin may have gone into outerwear jackets in 1954.

The film and sheeting business in 1954 was chaotic and confusing. The figures given for film in Table VIII may be from 5 to 10 million lb. in error; there are many uncertain factors. They include the 8 or 9 million lb. of foreign resin that came into this country for calenderers during the year. The foreign resins were bought at prices of from 30 to 35¢ a pound. The lower cost material was used for blending with domestic resins. Further confusion is added by the fact that one major producer now insists on classifying everything of 8 mils or more in thickness as sheeting, whereas everything 10 or under is classified as film by other producers. Consequently, the important figure to watch is a combination of the two which should be about 130 million lb. in 1954 in contrast to about 125 million lb. in 1953.

The film and sheeting figures are becoming more and more intertwined each year because there are so many products that may use either, and there are several well concealed items about which producers are reluctant to talk. The sheeting figure also includes several million lb. of rigid vinyl sheeting used for maps, printing plates, playing cards, templates, and signs. The increasing use of vacuum forming machines should create steadily growing markets for this type of material.

Inflatables, using vinyl from 8 to 20 mils thick are not included in Table VIII. Consumption for inflatables declined several million pounds in 1954.

Film and sheeting used in lami-

nates for table tops, upholstery, and table covers is a vinyl use that will spread to many other applications. It is a field with promising prospects for the future.

Cast and Extruded Film—In the film group in Table VII, p. 80, at least 2 million lb. of cast and extruded film is included. [illegible] film is by far the largest with a [illegible] portion of the output used for storm windows. Medical tape was another sizable use. Thin, extruded, clear film in big volume has long been a dream of the industry, but it has been slow coming. This year, however, a big textile firm adopted it for wrapping bed sheets and other white goods. Extruded vinyl film may finally be on the march, if other textile mills follow the leader. However, the use is still limited to wrapping because the film is likely to block when used in bag form. It will probably be several years before volume reaches as much as 10 million pounds.

Saran film is *not* included in Table VII. The Government lists all saran in another classification under "other vinyls" (see Table I, appearing on p. 68).

Drapes Suffered—The profit situation in the calendered vinyl film market was in just as chaotic a condition in 1954 as in 1953. Vinyl drapes suffered severely. Several prominent drapery producers quit the vinyl business. Some of the better department stores eliminated them from stock. Valiant efforts are being made to regain the lost markets by upgrading the product and adopting high standards. Most film converters who are successful now insist on thicker film and high-grade styling. Laminates, too, are being used to increase quality. Educational campaigns to help customers understand how to select better quality in vinyl are under way. But the evils of a system whereby a low-cost item is merchandised by wholesale price slashing are hard to overcome. The drapery market may have hit bottom in 1954. There is some hope that it will start an upward climb again in 1955.

What is happening to the rest of the film market is well delineated in Table VIII, p. 81. These figures should in no sense be taken as an attempt to pin-point the actual poundage for each item. That is impossible. But Table VIII does serve to present a pattern that indicates trends in

film products and gives an idea of how the market is divided.

A bright star in the film firmament was born in mid-year when an adhesive-backed film for wall covering was brought out. One store in New York claims to have sold 17 miles of it in the first four weeks it was on display. In October the producer was reported to be three or four months behind in filling orders.

This wall covering material is an example of one of the nice things about vinyl. The basic film is so utilitarian that a drop in one market is frequently offset by a rise in another. The whole wall covering field looks attractive. Vinyl-treated paper, vinyl to fabric laminates, and the adhesive-backed vinyl film are all prospects that could use up millions of pounds of resin within the next few years.

Rigid Vinyl—The big unknown in future vinyl chloride progress is rigid or unplasticized vinyl. Less than 5 million lb. of resin were used for this purpose in 1954. About 1 million of that is thought to have gone into pipe. Pipe progress has been handicapped by lack of molded vinyl fittings, but that problem is now well on the way to solution. Fittings represent about 35% of the cost of a normal pipe job.

There seems one certainty in the development of vinyl pipe: when it starts taking hold there will be a rapid upsurge, for it will have had plenty of time to be well tested. One producer has enough confidence in the future of pipe to have built a plant with space for 42 extrusion machines; five extruders have been installed as a beginning.

The balance of the rigid vinyl is used for signs, tank linings, ducts, and panels. Here again time is required for testing. And again the evidence of confidence is expressed by a large rubber company that has built a huge new plant in Ohio to fabricate unplasticized vinyl sheet exclusively.

Still another prospective use was displayed at the Cleveland show where the possibilities of fabricating rigid vinyl sheet on a small stamping press were demonstrated. Scores of metal stamping establishments indicated their interest and several are now experimenting.

In vinyls other than the chloride type, there was not much change in 1954 over 1953. Polyvinyl acetate grew from around 44 million lb. in 1953 to around 50 million lb. in 1954. It is used primarily for adhesives, textile treatment, and paint. The latter was the smallest use in 1953, but analysts think it may go to 50 or 60 million lb. within five or six years. Adhesives accounted for at least 25 million lb. in 1954. There are now at least 17 and probably more polyvinyl acetate polymerizing companies in the United States.

Saran film for household use made its television advertising debut in 1954. Dow, the producer, gives no indication of how much film has been produced or sold, but thousands of distribution outlets are well stocked. It is a certainty that millions of pounds of vinylidene chloride resin were used up in producing the film, and if there is any doubt about sales volume, all one needs to clear it up is stand at the checking counter in a food store and watch the number of women who walk out with rolls of film in their grocery baskets. Commercial film sales of saran for packaging cheese, candy, and meats are believed to have increased about 30 per cent.—END

Nylon

(*From page* 82)

Alfred C. Toepfer, and Nova Chemical Corp. Other producers of nylon for fabric in this country have given no indication that they will have plastic nylon available.

There are many different opinions as to the comparative properties of nylon 6 and nylon 6,6. It is claimed that nylon 6 (caprolactam) will make a good fish line but might not be good for paint brush bristles, since it doesn't have snap-back. Also that nylon 6 is tough and has good abrasion resistance, but is soft and rubber-like. It would be satisfactory for hammer heads but there is a question as to its usefulness for molding items, such as gears, that require hardness. One analyst familiar with both materials says that nylon 6 is more rubbery—not as rigid as nylon 6,6; has more predictable shrink characteristics; absorbs more water and, therefore, is less dimensionally stable; has a lower softening point.

It may be significant in all this controversy that Du Pont has had a caprolactam formulation for years, but seems to prefer the nylon 6,6 type.

Price—The question of price is, of course, a factor. There are many rumors afloat that caprolactam will be less costly than nylon 6,6, but the final answer has not yet been given. It is true, however, that nylon 6,6 at $1.60 a lb. has a price handicap for big volume use although there are many molders who prefer to handle high cost materials because their profits are frequently better in that kind of an operation.

At today's prices a cubic foot of nylon costs about $110 compared to $18 for phenolic; $21 for polystyrene; $36 for cellulose acetate; and $39 for melamine. If nylon were $1.00 a lb. it would cost about $68 a cubic foot. There are some analysts who believe that if nylon dropped to $1.00 a lb. its use would double, but even so the volume would still be small compared to other plastics.

The price question is still up in the air, but even if there is no change it certainly seems safe to predict that nylon molding material will continue to increase its sales volume for as long as anyone can presently foresee.—END

Polyethylene

(*From pp. 82-84*)

purposes alone in 1955, and of course, most of it will be film.

Molded Polyethylene—Injection molded polyethylene (Table IX, p. 83) is next fastest grower in the field and its rate of growth may become even faster than that of film. An article in the November issue of MODERN PLASTICS illustrated a few of the possibilities. From a volume standpoint, housewares are the chief molded polyethylene products. Volume of all plastics housewares is expected to reach a total of 80 or 90 million lb. in five years or less and polyethylene may then account for at least half of the total. The field is still widespread. Despite its presence on all housewares counters and an aggressive producer-to-user campaign by a large molder, there are still millions of housewives who are unfamiliar with polyethylene dishware and other housewares items.

The leading molder of polyethylene housewares says that his 1954 sales will show a 200% increase over 1953 and that he expects to increase that business by 150% in 1955.

Closures is another growing outlet. Compared to housewares, volume is limited, but the number of applications for polyethylene closures is increasing. One feature that helps is that no liner is required. Polyethylene is by no means likely to take over the whole field, but it will broaden the base for plastics closures. An example is the plug for cylindrical glass cigar containers. For medicines, cosmetics, toiletries, and caps on collapsible tubes it has already won foremost recognition.

Specialty Uses—Then there are various specialty moldings that will take time to catch on. Combs are an example. They have been difficult to promote, but if past experience is a criterion, they will eventually become popular. Most women look at them with eyes askance until they become familiar with their flexibility and longevity. There is almost never a broken tooth in those combs.

Industrial moldings in polyethylene are in their mere infancy. In such products as battery parts, they are certain to grow. Chemical resistance, low temperature, flexibility, and ease of molding are properties that must sooner or later win a big market for polyethylene molded parts.

Polyethylene for electrical purposes, chiefly wire coating, is thought to have declined in 1954 (Table IX) because of the Army cutback in assault wire, the huge demand for which was one of the main factors in making polyethylene so scarce during the Korean war. However, the civilian use came along so well in 1954 that there are many estimators who will disagree violently with the figure in Table IX and will claim that wire and cable use ought to be placed even higher in 1954 than it was in 1953. Part of the civilian demand has been for telephone wire of the type that is covered with braid, encased in aluminum, and then covered with polyethylene. The aluminum and plastic have replaced the once conventionally used lead.

Television lead-in wires are also conventionally coated with polyethylene, but reports indicate that a lot of scrap has seeped into this particular market.

Irradiation—Another development of particular interest to the electrical industry is the process of irradiation, by which polyethylene becomes a high heat-resistant material. So far, only a small amount has been made available in the form of film and at a rather high price, but the process has possibilities. One manufacturer is providing it in sheets for fairly large parts where high heat resistance is mandatory. Another manufacturer is incorporating boron compounds in polyethylene to improve its heat resistance.

Polyethylene coating on paper, film, and foil took a good step forward in 1954. There are now between 20 and 30 firms in the business. Some of them are not doing much business, but a few have worked three shifts a day for five days a week over long periods of time. The 23 million lb. of polyethylene (Table IX, p. 83) used for this purpose indicates a tremendous volume of coated stock, since a small amount of polyethylene will cover a large area.

Included in the figure, too, are polyethylene and paper, or film laminates. Polyethylene coating on cellophane is probably the most talked about product in this field and is expected to show ever-increasing volume for some time to come. It has been particularly recommended for

packaging meats, orange juice and other liquid products, and vacuum packed foods where low gas transmission is important. The combination of polyethylene and cellophane gives a group of properties, not all of which can be found in either material alone. These include toughness, clarity, heat sealing, grease resistance, printability, control of water-vapor transmission and other desirable packaging qualities. Use of the two together is likely to broaden the base of application for both to an as yet unestimated volume. The cost of the two when combined would be around $1.00 a lb., considerably more than either of them alone, but still a reasonable price for the specialty uses to which it will be put.

The sensational growth of polyethylene for pipe is still going on—probably will for two or three years. Analysts believe that as much as 60 or 70 million lb. will be used annually in 1958, after which time volume is expected to grow slowly from year to year. There are not too many uses for polyethylene pipe outside of conveying cold water, but that in itself can become a huge market.

Bottles—Although polyethylene is often referred to as "that squeeze bottle plastic," there is less used for that purpose (see Table IX, p. 83) than in any of the other classifications named here. Growth has been somewhat slower than expected. There have been problems of distribution, competition with much lower cost glass, and long periods of testing that must be undergone before it can be determined whether or not polyethylene is a suitable container for the product to be packaged. For example, polyethylene bottles just don't seem to be practical for certain things such as catsup and fine oils.

Competition for squeeze bottles is also coming from other sources. Aerosols in metal or possibly glass containers which have atomizers or sprayers attached are growing at an unbelievable rate. It is estimated that some 200 million were delivered in 1954. Each one has a small polyethylene tube and some have molded polyethylene parts in the spray valve, but the poundage involved for these per container is small. Incidentally, both nylon and melamine are being experimented with as containers for aerosols. The glass indus-

try is also moving to compete with polyethylene squeeze bottles and metal aerosol containers. For example, glass bottles coated with vinyl plastisol or jacketed in a vinyl sack are being promoted for use as aerosol containers. The entire bottle business is in a state of evolution that could result in many changes over the next few years.

But the polyethylene bottle business is far from declining. It may have decreased in rate of growth, but the number of producers has increased and this competition has stimulated initiative of all concerned. Sales have grown from about 30 million units in 1949 to about 200 million in 1954; but, even so, the increase in the past two years has fallen behind expectations.

Collapsible Tubes—A new development in this field has been the production of polyethylene collapsible tubes and cylindrical bottles. The producer of these new containers operated at a rate of 600,000 a week in October and expected to quadruple that amount in a short time. Nozzles that permit spraying, brushing, or drop-by-drop dispensing are included in the new line.

Cosmetic jars are also considered as part of the bottle business. Here, double wall construction is being used to combat the permeability problem. In fact, the cosmetic business should serve as a reminder that aerosols and squeeze bottles have certain limits, too. Not everything can be dispensed as a spray and the polyethylene bottle doesn't have to be a squeeze bottle. Such things as detergents, medicines, and a great portion of "bathroom" liquids, powders, creams, etc., will be packed in bottles that have large caps which also serve to measure the contents as it is poured out.

The new octagon-shaped nursing bottle that took the country by storm last year to the tune of nearly 20 million units is another example of how a polyethylene bottle that is not necessarily a "squeeze" type can be exploited. Then, too, the carboys for chemicals that are made as large as 13 gal. help to give an idea of the volume in the bottle market.

Sales Problems Ahead—No one denies that polyethylene sales managers are going to sweat, bleed, and cry for the next two years. They are going to have a potential supply of 550 or 600 million lb. to sell to a market that consumed only 200 million lb. in 1954. The extent of the sales problem may be realized by a quick look at the following guess as to how the market might be divided when sales get up to 600 million pounds:

Film	200,000,000 lb.
Pipe	90,000,000 lb.
Bottles	30,000,000 lb.
Electrical	85,000,000 lb.
Injection molding	155,000,000 lb.
Coatings	40,000,000 lb.

Boosting sales from present levels to the above quantities is no job to take lightly. Perhaps it will take longer than the contemplated three or four years, but there are plenty of brainy men in the industry who are betting that it can be done.

The cream of the crop—the obvious applications for polyethylene—has already been skimmed off. It may take a disheartening length of time to develop new fields, but history to date is full of new applications that caught hold in a few months. Polyethylene is so utilitarian and low in cost that there are probably scores of big volume applications that will be found every year for some time to come.

And, finally, there are many technical improvements coming along that will make polyethylene even more suitable for broader scale applications than it is today. Improved printing methods, better adhesives, better equipment for handling it in packaging machinery, compounding with other materials to give added properties, use with other materials in laminates or otherwise, more clarity, more heat resistance, and more rigidity are a few of the improvements that may be added to make polyethylene even more utilitarian than it is today.

It still seems reasonable to believe that polyethylene will be the largest volume plastic within four or five years, but there is almost certain to be considerable commotion before it gets there because new capacity is coming along in bigger volume than industry can absorb at so rapid a pace. One may enter the polyethylene industry with his mind set on great prospects for the future, but his pockets had better be well lined with greenbacks to carry him over the rough spots before he starts buying that new house with golden stairways, diamond studded door knobs, and mink-lined bathtubs.

Applications

(*From page* 85)

consideration of the possibilities inherent in the technique.

Sharing credit with new processing techniques for gains made in plastics applications in 1954 are the newer materials which were made available during the year in greater quantities than ever before.

In vying for the consumer dollar in 1954, industry-wide thinking was directed towards adding extra value to plastics products in the form of improved appearance and performance. To accomplish this, many manufacturers placed major emphasis on the newer high-impact materials, especially polyethylene and the styrene alloys. The former material, in particular, had a record year. Spurred by announcements of an increase in production capacity, the number of consumer and industrial products molded or extruded of polyethylene increased correspondingly (MPL, Oct. '54, p. 91). Similarly, the styrene alloys, both in sheet and molded form, were put to greater use in the design of a wide range of products.

As was the case with processing techniques, this trend in materials use, while certainly a dominating one, cannot be labeled as solely responsible for the banner year of 1954. Materials suppliers concentrated on formulation perfection of plastics which were tailor-made to meet the demands of specialized end-uses. Examples include vinyl sheets with increased stability to light for various lighting applications; fire-resistant polyester resins for reinforced plastics structural panels; styrene sheet with integral gloss for refrigerator applications; epoxy resins designed for use in potting or as a casting material for tools; and a long list of other specialized materials for specific markets.

The result of this activity is partially indicated by the individual applications reviewed in the section beginning on p. 85. While this review cannot possibly encompass all of the developments which have been recorded month-by-month in the pages of MODERN PLASTICS, the products described do serve to illustrate the over-all progress made in plastics applications in 1954.—END.

Toy Instruments

(From pp. 98-100)

component parts are molded of high-impact styrene with a minimum wall thickness of 0.100 in. to give strength and reduce the possibility of breakage. The parts are metallized before being assembled.

After metallizing, the complete elbow is cement-locked to the bell by means of the bayonet joint to form the bell assembly. When the two body sections are cemented together, the upper end forms a sleeve which makes a friction fit with the elbow, permitting the bell assembly to be rotated as desired when the toy is in use. The mouthpiece and extension are cemented together and inserted through a ball socket mounted and held in place by the two halves of the sound box. Assembly of the sound box, complete with plungers, is accomplished by the use of Parker-Kalon self-threading screws. This unit slides into an opening in the body, where it is locked in place by a single brass screw and is easy to remove for repair, if necessary.

Vacuum metallizing imparts a bright and lasting metallic finish to the musical toys; the 0.100-in. wall thickness of high-impact styrene, coupled with proper mold design and precision molding, assures that the tuba can absorb a considerable amount of abuse without serious damage to the molded parts. So certain is Emenee of the durability of the toy tuba that the company guarantees the toy against breakage, against failure of the sound box, and against fading of the metallized finish for a year after purchase.

With an eye toward continuing future sales, the complete Emenee toy musical instrument line is being pitched to the same musical key, so that children can form their own bands and play the various instruments in combination.

So enthusiastic has been the acceptance of these all-plastic toy musical instruments that further development work is being carried on and Emenee foresees the time in the near future when its line will include realistic, durable, playable reproductions of all popular musical instruments . . . in plastics.

CREDITS: Styrene supplied by Bakelite Co., Catalin Corp. of America, The Dow Chemical Co., and Monsanto Chemical Co.

Engineering in 1954

(From page 105)

it was required that an acid-resistant coating be applied. The finalized process included application of a resin sizing followed by a coating of a resin cement, an intermediate layer of silicon dioxide and polyethylene, and an outer layer of flame-sprayed pure polyethylene.

The equipment used in this process consisted of a material hopper and a carburetor, hose system, control valves, and torch which not only can control the temperature of the sprayed polyethylene, but will also permit variations in spray conditions without change in flame setting.

Thickness Gaging and Control, by W. T. Eppler, (May issue), gave complete information on equipment and methods used for automatically gaging and controlling the thickness of a polyethylene jacket extruded onto certain special telephone cables.

This procedure appears to be the basis of a method for non-destructive, continuous measuring of the wall thickness of extruded plastic pipe and tubing. The equipment as described, with suitable modifications, might be adapted to such work.

Automatic Injection Molding, by Ernest P. Moslo, (May issue), described the essentials of automatic machinery and gave details of several jobs run on such equipment.

A New Look at Extrusion, by Herbert O. Corbett, (June issue), described the different types of extrusion machines and equipment available today. The author made direct comparisons between such items as oil and electrically heated machines and different types of variable speed drives. He also outlined the results of research which has been undertaken to obtain a good basic design approach in tooling an extruder for production. His main points were: 1) that interchangeability in die design was of first importance and 2) that it is unnecessary to build extrusion dies by the "cut and try" method. The author made the following statement: "Any die orifice machined to say 20% greater dimensions than the desired finish section size, with uniformity of section—that is, the same wall thickness throughout—should result in a perfect extrusion on the first trial." That this concept is sound is indicated by the author's experience in extruding polyvinyl chloride, polyethylene, polystyrene, methacrylate, cellulose acetate, cellulose acetate butyrate, and ethyl cellulose with nearly equal efficiency from the same basic die design.

How to Make Flexible Model Molds, by Edward Ferrari, (July issue), completely covered, step-by-step, all of the operations required for making prototype reproductions from flexible molds. Thirty-five drawings clearly illustrated each step in the operation of preparing the mold and casting the prototype.

Balanced Gating, by David A. Jones, (December issue), presented a formula which makes it possible to calculate gate dimensions for multi-cavity molds or for multi-gated, single-cavity molds. Several conditions must be met, however, before this formula can be used. For example, the mold must have full round runners of uniform diameter and a streamline effect should not be present at the gate. No conditions should be present in the runner system which would cause a high pressure loss and, in multi-gated

single cavities, the distance from gate to weld line must not be less than the distance from the gate to the end of the part.

The following articles published in the Engineering Section of MODERN PLASTICS Magazine during 1954 are listed by title only, for reference.

Increasing Molding Efficiency; and **Polyethylene Pipe Flanging,** by Flave Pledger and D. J. Ryan. (March issue.)

Vinyl Foamed With Gas. (April issue.)

Lighting System Redesigned in Reinforced Plastics, by Sidney D. Yarm and George L. Hinds. (July issue.)

Extrusion of Acrylic Rod. September issue.

Glass Fabric Finishes Vs. Fiber Sizings, by L. M. Calhoun; **Drying Ink on Polyethylene Film,** by Gene Liberty; and **When and Why to Use Drape Forming,** by George H. Howell. (October issue.)

Pipe Made at Point of Use; Case History of a Terminal Block; and **Dust Irritation Problems,** by Roger B. White. (November issue.)

Decoration of Thermoplastics, by John I. Graham. (Dec. issue.)—END

Reinforced Sheet

(From pp. 105-106)

tion of 3M FC-400 mold release on a clean mold surface, from four to six clean partings should be obtained before re-application of the release agent is necessary.

With the mold hot, the sheet is formed by closing the mold gradually as the sheet becomes thermoplastic. As soon as the sheet has been formed, full molding pressure is applied for a moment and then released to minimum contact pressure for the gel period. Full molding pressure of 25 or more p.s.i. is then re-applied for duration of cure.

Typical total cure times, including gel period, are as follows:

10 min. at 400° F.
and 25 (or more) p.s.i.
35 min. at 330° F.
and 25 (or more) p.s.i.
100 min. at 270° F.
and 25 (or more) p.s.i.

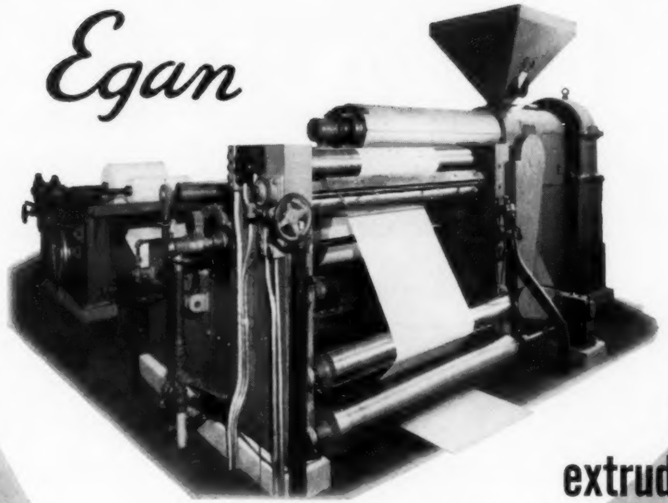
The first set of conditions given above is preferred. While a lower temperature may be used, it must be at least 270° F.

Pilot plant production of Scotchply is now running approximately 30,000 lb. per month. Production equipment now being installed, however, is expected to have an initial capacity of around 1,000,000 lb. per month after the first of the year, according to present plans. When volume justifies, on parts of complex shape which might require cutting or tailoring to conform smoothly to the mold, Minnesota Mining is in a position to supply precut sheets of the approximate size and shape, minimizing additional operations in the fabricator's plant. On parts requiring differential wall sections in certain locations, additional thickness at corners, etc., additional strips may be superimposed.

In evaluating the new material, 3M officials point out, molders should think in terms of total part cost and "built in" properties made possible through use of the Scotchply sheet. Elimination of the customary preforming and resin saturating of the glass fiber reinforcement saves plant time and labor prior to the actual molding operation and permits employees to concentrate on actual production of finished parts.

(MODERN PLASTICS, December 1954.)

Egan



polyethylene extruder-laminator

(Above pictured installation at the Milford, N. J. plant of RIEGEL PAPER CORPORATION)

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Polyester-Glass

(*From pp.* 116-118)

a process that would least degrade the glass fibers. It was found that the maximum amount of glass that could be mixed in the compound in this way with a reasonable amount of effort was 20% by weight. The material appeared to be uniformly mixed, and there was no evidence of any appreciable incidence of fiber breakage in the compound.

A quantity of compound was made using each of the three methods described above. The hand mixed material and the sigma blade mixed material contained 20% glass fibers by weight. The Brenner cutter compound contained 30% glass. These materials were tested for flexural strength and Izod impact strength and the results were analyzed statistically. The following statistical concepts were used[2]:

Standard Deviation is a value calculated from the experimental data which measures the amount of deviation of the individual determinations from the mean or average.

Coefficient of Variation is a measure of the variation of the experimental data and is calculated as the standard deviation divided by the mean.

Confidence Limit is a value that defines a range of measurements and is calculated so that, with an agreed probability, any experimental data will be within this range. In the analysis of the experimental data, a confidence limit was used such that 95% (the agreed probability) of all values would exceed this limit.

The results are presented in Figs. 3 and 4. By reference to these charts it can readily be seen that the hand mixed compound had high average strength, but was non-uniform. This is particularly noticeable in comparing the Flexural Strength 95% Confidence Limit with the Average Flexural Strength. The material produced using the Brenner cutter had the highest strength of the material tested here and it too was quite variable. The compound mixed with the sigma blade mixer was found to have the lowest strength although it was more uniform.

(Harry R. Sheppard, MODERN PLASTICS, April, 1954)

[2] Dixon, W. J. and Massey, F. J., Jr., "Introduction to Statistical Analysis," McGraw-Hill Book Co., New York.

Big Mold Problems

(*From pp.* 118-121)

but other factors enter the picture so that machinability problems cannot be anticipated entirely on the basis of hardness. This fact is borne out by Newark Die's experience in machining prehardened steel. Even though it Rockwelled 34 to 36 on the C scale, the mold maker states that it was necessary only to reduce the speed of the cutters and feed slightly in order to produce a good cut.

After the practically automatic Keller operation of machining the details on both the force plug and cavity had been completed, the next step was fitting or spotting.

After it had been ascertained that the mold would produce a part to the required dimensions, the next step was to produce a very high luster on the molding surfaces.

Because no heat treatment after machining is required with this special mold steel, and, therefore, no carbon was added to the surface of the steel, there were no hard carbides in the steel structure to cause non-uniform polishing conditions. The final polishing of the mold to eliminate the marks of milling or riffle filing was done by hand, using silicone-carbide abrasive stones.

The final high gloss was produced by buffing with special polishing compounds on buffing wheels which were operated from flexible shafts.

The next step, after the mold had been set up in the injection machine at Bridgeport, was to run samples, check their dimensions, and submit them to York for their approval. As soon as molded pieces were available, a special fixture was built for cutting all the multiple gates cleanly and at one time.

Limited production was begun in order to "work-in" the mold and determine optimum cycle times, pressures, and temperatures. It was found that the fastest injection speed available in this machine could not be used since it caused weld marks in the ribs of the grille work. Speed of injection was finally worked out so that the total weight of the shot (35¼ oz.) was delivered into the mold in slightly under 4 sec. with injection pressure of 150 to 160 tons.

(Islyn Thomas, MODERN PLASTICS, June 1954.)

Machine Sales

(*From page* 122)

automatics indicates that many molding jobs, which could conceivably have been run in molds having a very large number of cavities, are now being engineered with comparatively few cavities and are being run in small fully automatic machines. There is no doubt that this trend is caused by high labor costs which are, of course, practically eliminated when production becomes a matter of fully automatic operation.

An interesting and encouraging aspect of the over-all situation, from the machinery builders' standpoint, is shown in the tabulation of export figures for both injection and extrusion machines. In 1953, as Table II, p. 122 shows, 109 injection machines were exported; in 1954 the tabulation shows a total of 108 machines. In the extrusion machine field, the same trend holds true. (See Table III, p. 122.) In 1953, a total of 91 machines were exported, as indicated in the tabulation; and in 1954 a total of 90.

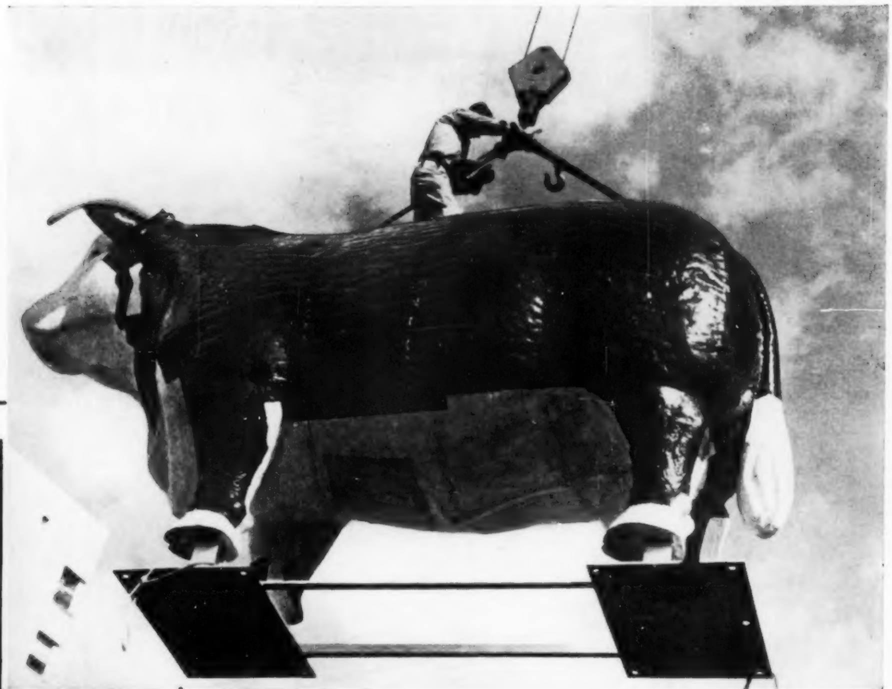
The extrusion machine sales were tabulated from the sales figures of eight machinery manufacturers; in the case of injection machines, the totals were obtained from the sales of 13 injection molding machinery manufacturers.

Not included in the figures on injection machines is the number of "custom built" machines in the industry. This was reported last year to total between 550 and 650 units. It is doubtful if more than 30 or 40 machines of this type have been added, which would bring the total number of "custom-built" injection machines in the industry, as of the end of 1954, to between 580 and 690 units.

Domestic and export shipments of injection molding machines for the years 1952, 1953, and 1954, broken down according to capacity in ounces, are listed in Table II, appearing on page 122.

Domestic and export shipments of extrusion machines (including twin screw type extruders which are added to the single screw size according to capacity) for the years 1952, 1953, and 1954, broken down according to screw diameter size in inches, are shown in the summary listed in Table III, page 122.—END

BIGELOW
Fiber Glass Products



Lew Edwards of Colonial Plastics Corp. holding the original plaster model, and standing between the 12-foot tall bull and its 3-foot prototype.

A little bull goes a long way . . .

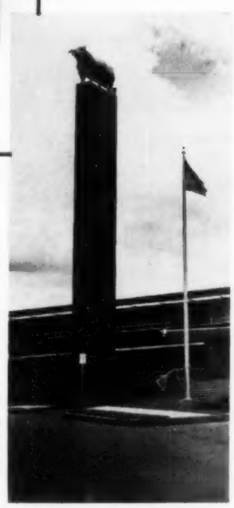
From 6-inch high plaster model to 12-foot tall Bigelow Glass-Mat bull . . . from a plant in North Bergen, New Jersey to the top of a 90-foot pylon in Kansas City, Missouri . . . that's the saga of this pure-bred Hereford bull!

Simultaneous with its appearance atop the American Hereford Association building in Kansas City, this fantastic bull made its debut in a feature article in LIFE magazine, October 25th.

500 square feet of Bigelow Glass Mat went into the making of this fiber glass bull, bag molded by Colonial Plastics Corporation of Newark, New Jersey for Colonial Neon Co., Inc. of North Bergen, New Jersey.

Colonial chose Bigelow 4-ounce FORMAT* for this unusual job because of its outstanding ability to conform readily to intricate curves and details.

* A Bigelow Trademark



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1954 in Review

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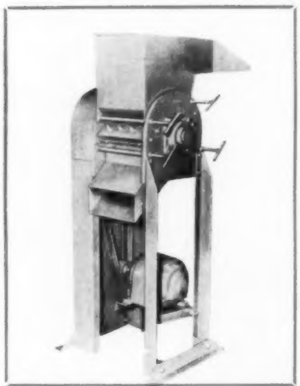

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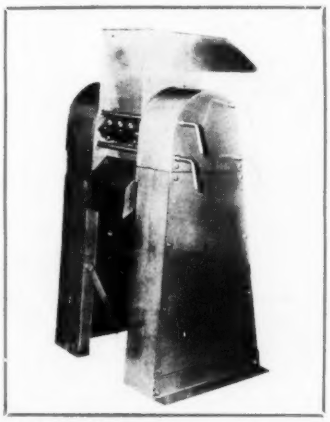

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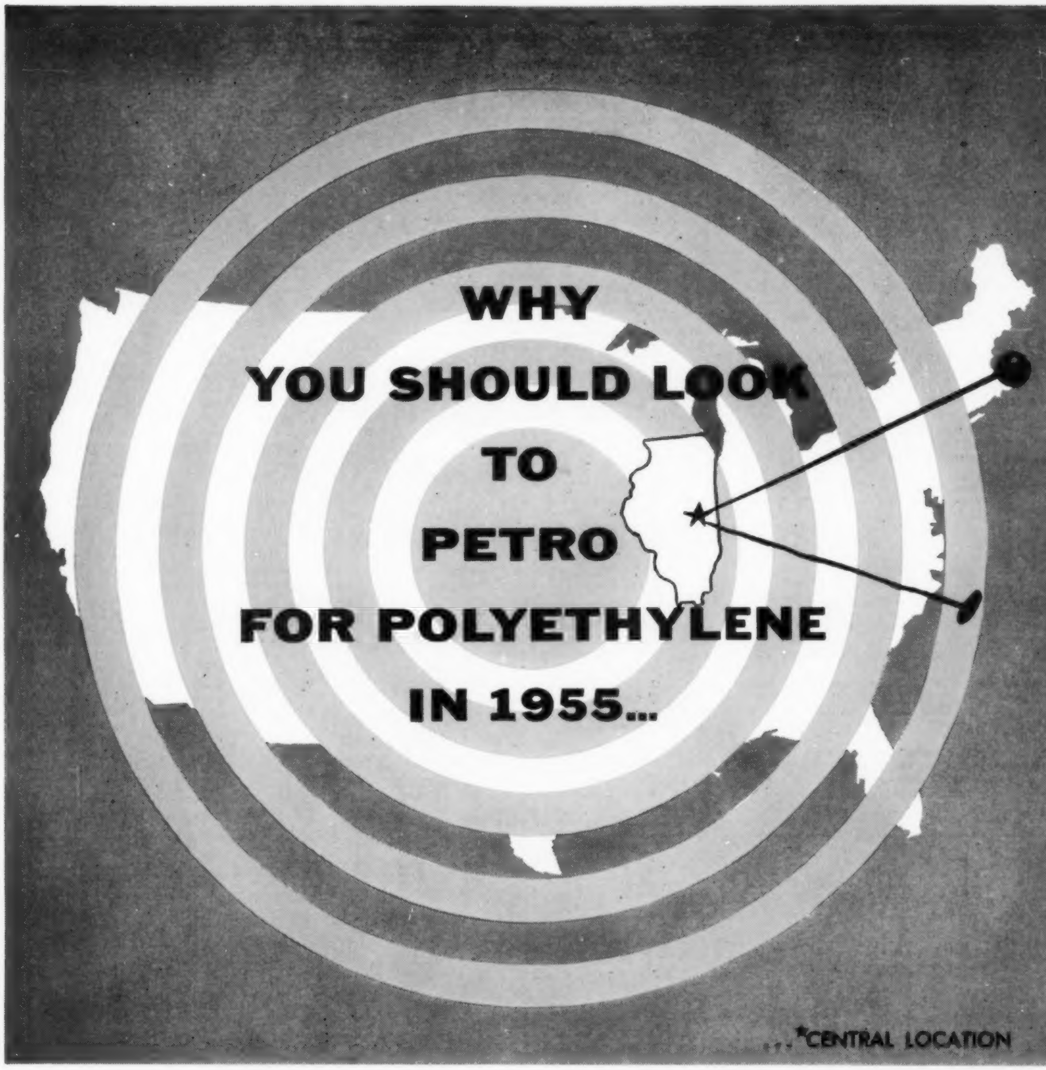
WHY
YOU SHOULD LOOK
TO
PETRO
FOR POLYETHYLENE
IN 1955...
...*CENTRAL LOCATION

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NEWS AND INTERPRETATIONS OF THE NEWS

By R. L. Van Boskirk

New Producer Puts New Polyethylene Plant into Production

FIRST in the parade of six new producers who announced that they would enter the polyethylene field this year is Texas Eastman Co., with an $8 million polyethylene plant in Longview, Texas, which started production on a commercial scale in late November. The material, called Tenite polyethylene, will be marketed by Eastman Chemical Products, Inc.

Base material for Tenite polyethylene is propane, a refinery by-product from which ethylene is produced and then converted into polyethylene. The new plant has a capacity of 20 million lb. annually. It is being produced under a licensing arrangement with Imperial Chemical Industries Ltd. of Great Britain.

Spherical Pellets — Outstanding feature of the new polyethylene material is its entirely new form—spherical pellets—for both molding and extrusion. This form is claimed to have numerous advantages for the user. The spherical pellets will flow more uniformly from the hopper of the molding or extrusion machine. This reduces the chance of bridging-over, which often happens with cubical pellets or granulations. Polyethylene pellets of the new type are easier to keep clean in storage and use. Their smooth spherical surface will not readily catch or hold dust and foreign particles. Also, it is estimated that they have a 10% lower bulk factor, thus requiring less storage area. Because of the fewer fines with the spherical pellets, it is easier to clean the hopper of the molding or extrusion machine when changing color.

Tennessee-Eastman is an old hand at springing new tricks in pelletizing. Old timers in the industry will remember that it was this company that first brought out uniformly square pellets in acetate and butyrate as an improved material over the former irregular-shaped granulations.

Carload shipments of Tenite polyethylene will be made from Longview, Texas, and less-than-carload shipments as well as shipments of colors from Kingsport, Tenn. Tenite polyethylene will be offered in a wide variety of colors and color concentrates. The prices are 41¢ a lb. in 2300 lb. or more for Group I molding, extrusion, and blowing material; 43¢ a lb. for Group II; 46¢ for electrical grade; and 50¢ for general-purpose standard colors.

Company officials are particularly enthusiastic over their film grade material which their own tests indicate will produce film of highest quality and a minimum of fish-eyes.

How it Was Tested—The first certificate of necessity which Eastman obtained for production of polyethylene back in the Korean war days caught the entire chemical industry unprepared. Now the announcement that production is actually under way is not exactly a breath-taker, but just when, was a question of long standing. No samples or test lots were found in processors' plants and the trade wondered how Eastman could enter the market without testing in the field. The answer is now clear. They did all the preliminary molding and extrusion test work on their own premises in strict secrecy and were fully prepared to prove the quality of their material when it went on the market.

No announcement has been made concerning what the company expects to do about its plans for low molecular weight polyethylene. A certificate of necessity was granted to it for the production of low molecular as well as high molecular weight material, but apparently company officials have not fully decided what course they plan to pursue for this material which, up to now, has been largely used in waxes.

*Reg. U. S. Pat. Off.

One-Mil Vinyl Film

SUCCESSFUL conclusion of an extensive department and field testing program on a new 1-mil extruded vinyl film for textile packaging has been announced by The Goodyear Tire & Rubber Co., Akron 16, Ohio.

Designated as Vitafilm, the textile wrap is reported to be a tough, economical thin-gage film which has excellent printability and can be handled easily on most wrapping machines with only minor conversion.

The film is now being used on a full-scale commercial basis by several major textile mills and is under test by other firms. It can be printed by both flexographic and rotogravure processes, and vinyl inks are now available from leading ink manufacturers.

Special techniques necessary for printing the 1-mil film include careful control of tension to eliminate stretch and use of air at 100 to 110° F. for drying. It is stated that Vitafilm can be easily heat-sealed to make strong film-to-film welds that will not come apart and are not affected by either high or low moisture conditions. It is reported that heat seals can be made on automatic overwrap equipment at high speeds.

In addition to a packaging material for textile goods, Vitafilm is recommended as a packaging film for paper products, industrial and hardware items, toys and novelties, and various laminations.

Vitafilm is furnished in 9-in. diameter rolls; yield is approximately 21,500 sq. in. per pound.

Improved Laminates

SEVERAL types of improved laminates—G-E Textolite Grades 11561, 11562, 11563, 11564, and 2054—have been introduced by General Electric Co.'s Laminated and Insulating Products Dept., Coshocton, Ohio.

Grade 11561 is a punching-grade phenolic laminate claimed to provide exceptional cold-punching

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qualities at a substantially lower cost than comparable industrial laminates. It could be punched cold to 1/8 in. and sheared cold to 3/32 inch.

Grade 11562 possesses good flexural and dielectric strength.

Grade 11563 exhibits good electrical properties and a high degree of resistance to chemicals.

Grade 11564 is reported to be ideal for high-frequency applications under severe humidity conditions. It is characterized by outstanding hot-punching qualities with excellent mechanical strength and uniformity.

Grade 2053, a hot-punching laminate, is made available at an even lower cost for operations employing hot-punching techniques. According to G-E engineers, this grade can be readily fabricated in thicknesses up to 1/8 in. by hot-punching and is well suited for use in terminal strips, sockets, spacers, and contactors.

Dow-Catalin Agreement

MANUFACTURING facilities of Catalin Corp.'s polystyrene polymerization plant in Calumet City, Ill., have been leased to The Dow Chemical Co., Midland, Mich.

By terms of the agreement, Catalin will now have for distribution Dow's entire polystyrene molding materials line, which means that it will have available such materials as high-impact, light-resistant, heat-resistant, and other polystyrenes in addition to the general-purpose material which has been manufactured at the Calumet City plant.

The capacity of the Calumet City polymerization plant was originally announced as 12 million lb. annually. The Dow Chemical Co. has announced no plans concerning its lease of the Calumet City plant except to confirm that the company has made an agreement with Catalin to take over its operations.

Foam Products

FLEXIBLE foamed vinyl and other plastics foam products for industrial applications, tradenamed Crestfoam, are being offered by Crest Chemical Industries, 72 Delavan St., Brooklyn 31, N. Y.

Open or closed cell structures are available in varying cell sizes, resiliencies, and densities ranging from 5 to 25 lb./cu. foot. Suggested applications include thermal and acoustical insulation, shock absorbing pads, molding gasketing, non-stiffening sponges, packaging nests, floats, and cushioning and soles for footwear.

A complete service from design and research to production runs is offered by the company.

Coated Rogers Board

STRUCTURAL and electrical insulating boards produced by Rogers Corp., Rogers, Conn., are now being coated with various types of plastic materials—epoxies, vinyls, alkyds, and phenolics.

The company states that the coatings reduce the rate of water absorption and moisture penetration and thus improve the board's physical strength as well as its electrical properties.

In one type of board, Rogers' Duroid-800, the water absorption for 24 hr. was reduced from 25% for untreated board to less than 10% by coating.

Coated materials are available in sheets 60 in. wide, coated on one or both sides. There are no thickness limitations. Coated Duroids can be used in place of phenolic laminates in many applications. The coating results in a high gloss finish and can be applied in various colors.

New Officers

ELECTION of the following officers has been announced by the American Chemical Society, 60 E. 42nd St., New York 17, N. Y.:

Dr. Albert C. Zettlemoyer, professor of physical chemistry at Lehigh University, was elected 1955 chairman of the society's Div. of Paint, Plastics, and Printing Ink Chemistry. Dr. Zettlemoyer is also research director of the National Printing Ink Research Institute.

Dr. Russell B. Akin, district sales manager of Du Pont's Polychemicals Dept., was chosen chairman-elect for 1956.

Henry Grinsfelder, head of the applications laboratory of Rohm & Haas Co., was named vice-chairman.

Dr. Allen L. Alexander, head of the Protective Coatings Branch of the Naval Research Laboratory, Washington, D. C., was re-elected secretary-treasurer.

Stabilizer Price Cut

PRICE reductions of 10¢ per lb. on two stabilizers—Advastab BC-105 and Advastab E-6-B—have been announced by Advance Solvents & Chemical Corp., 245 Fifth Ave., New York 16, N. Y.

Advastab BC-105 is a one-package liquid barium-cadmium stabilizer suitable for plastisol and organosol compounding, rigid vinyls, and calendered films.

Advastab E-6-B is a low-viscosity, non-volatile stabilizer that gives added heat and light stability with all types of stabilizers. In addition to its effectiveness in stabilizing vinyl resin compounds, Advastab E-6-B is also used to improve heat and light stability of chlorinated rubber compositions.

Glass-filled Silicone

DEVELOPMENT of a new glass-filled silicone compound for molding high-temperature plastics parts has been announced by Dow Corning Corp., Midland, Mich. Identified as Dow Corning 301 Molding Compound, it produces parts which may be pulled hot without cooling the mold. After-baking is unnecessary, except where parts are to carry a load at high temperatures. Properly molded parts are claimed to withstand continuous exposure to 450° F., plus intermittent exposure to as high as 700° F.

Dow Corning 301 may be molded with conventional equipment by either compression or transfer techniques. Mold shrinkage ranges from 0 to 0.0035 percent. Finished parts may be machined with high-speed tools.

D.D.P. for Wire Insulation

FOLLOWING several tests of Cabflex D.D.P. (di-decyl phthalate), a new use has been found for the compound for high-temperature wire vinyl insulation at lower formulation costs, according to an announcement from Plastics Chemicals Div., Godfrey L. Cabot, Inc., 77 Franklin St., Boston 10, Mass.

Cabflex D.D.P is claimed to have the lowest volatility of any primary monomeric ester commercially avail-

(di-decyl phthalate)

(di-iso-octyl adipate)

(di-iso-octyl phthalate)

(di-decyl adipate)

able as a vinyl resin plasticizer. For many years, tri-cresyl phosphate (T.C.P.) was the only commercially available primary monomeric plasticizer classified as having low volatility. For this reason, it was used as the sole or major plasticizer in all 80° C. vinyl insulation compounds by the wire and cable industry. In July 1952, the company introduced Cabflex D.D.P., an all-decyl phthalate which Cabot asserts was the first commercially available primary monomeric plasticizer to have a volatility lower than T.C.P. In addition, Cabflex D.D.P. is reported to offer the following advantages: low cost (9¢ per lb. less than T.C.P., based on current listed market prices); stability, with no discoloration during processing; less yellowing; practically no tack after exposure to ultra-violet light; low-temperature characteristics equivalent to D.O.P.; and low water extraction.

Hardened Steel Mold Clamp Sets

NEW PRICES on its line of hardened steel mold clamps have been announced by Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio, as follows:

Considerable reduction has been made in the price of hardened steel washers. Prices of the special oversize shoulder bolts and clamps have been slightly increased to cover costs of new high tensile steel now being used in the bolts. The clamps, washers, and ⅝-in. bolts come in sets of 8 at $55.15, or sets of 12 at $81.75. The clamp sets are designed for use with standard D.M.E. mold base sets.

The company states that the recent change in specifications have been necessitated by ever-increasing mold sizes, requiring the high tensile strength in mold clamps and bolts.

Plexiglas Price Cut

REDUCTIONS in large-quantity prices of Plexiglas acrylic plastic molding powders, both clear and in colors, has been announced by Rohm & Haas Co., Washington Sq., Philadelphia 5, Pa. The colorless powder is now offered at 69¢ a lb. for 5000 lb. to less than minimum truckload; for minimum truckload and over, the price is 68¢ a pound. Formerly, the lowest price for colorless powders was 70¢ a pound.

The colored powder is available in standard colors manufactured to order and in stock colors on which service inventories are maintained by the company. Both standard and stock colors are priced at 72¢ a lb. for minimum truckload and over; for 5000 lb. to less than minimum truckload, the new prices are 74¢ for the standard colors and 73¢ for stock colors. Prior to this reduction, the lowest price for colored powders was 75¢ a pound. All prices are f.o.b., the company's plant at Bristol, Pa.

Glazing Material

TRADENAMED Homalite CR-39, a new transparent, scratch- and abrasion-resistant glazing material suitable for a broad range of safety applications, has been developed by Homalite Corp., Wilmington, Del. The material is made of thermosetting resins.

Homalite CR-39 is claimed to offer optical and mechanical properties not generally available in either glass or transparent thermoplastic resins. It is immune to chemical action and is virtually unaffected by welding splatter.

Indicated uses for the material other than in glazing are in such applications as safety goggles and shields, instrument faces, grinding wheel guards, windows for viewing dangerous processes, and cab glazing on power shovels and cranes.

Bulletin 1052, furnishing information on the new product, and a free sample may be obtained from the company.

Epon Resin Price Reduction

ANNOUNCEMENT of a price reduction on Epon 828 epoxy resin has been announced by Shell Chemical Corp., 50 W. 50th St., New York, N. Y. New delivered prices for this resin are 80¢ per lb. in drum carload quantities and 83½¢ per lb. in less than drum carload quantities.

G. W. Huldrum, general sales manager, states that the rapidly expanding market for Epon 828 has permitted Shell to progress from pilot plant operations to full-scale commercial production.

Graduate Plastics Program

INSTITUTION of an engineering curriculum of graduate study and fundamental research in plastics leading to the degree of Master of Science in Engineering has been announced by Princeton University, Princeton, N. J. The plastics program, particularly suited for chemical, electrical, and mechanical engineers, as well as for chemists and physicists, is claimed to be the only one of its kind in existence in the country today.

The course covers properties, evaluation, production, fabrication, design, and application of materials, as well as chemistry of plastics. The program includes lecture and laboratory classes and contact with industrial plants representing various interests of the plastics industry.

Fellowships with stipends from $1500 to $2100, plus tuition and fees, are available. Opportunities for employment as half-time research assistants at $1500 per academic year are also being offered to students not on fellowships.

Applicants for admission must hold a Bachelor's degree in engineering or physical science from a recognized institution and must meet general admission requirements of the Graduate School of Princeton University.

Further information may be obtained from Louis F. Rahm, director, Plastics Laboratory, 30 Charlton St., Princeton, N. J.

Fluorocarbon Pipe

NOW available from Resistoflex Corp., Belleville, N. J., is a companion line to its Fluoroflex-T laminated pipe for light-duty use in low-pressure and gravity-feed systems. Also made of laminated fluorocarbon resins and glass fabric, construction is the same as for the heavier duty pipe, but use is limited to working pressures not exceeding 50 p.s.i.

The new lightweight pipe is reported to be ideal for handling corrosive liquids at elevated temperatures up to 500° F. and is easily handled and installed right on the job. The pipe is available in lengths up to 12 ft. and diameters of 1, 1½, and 2 inches. Standard corrosion-proof fittings are offered to facilitate

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installation of complete piping systems. Cost of the new light-duty pipe is expected to be about 25% less than the heavier duty pipe.

EXPANSION

The Borden Co.'s Chemical Div., 350 Madison Ave., New York 17, N. Y., is constructing a new polymerization unit adjacent to its industrial adhesives plant in Dominguez, Los Angeles County, Calif., geared for initial production of 3 million lb. of polyvinyl acetate emulsion a year for the West Coast paint industry.

Augustine R. Marusi, president of the division, states that the expansion was prompted by the sharp increase in demand for emulsion-polymer-based paints used for both interior and exterior work. He says that polyvinyl emulsions are in particularly heavy demand on the West Coast for masonry and stucco paints, a use developed largely by the Los Angeles paint industry.

The Chemical Div. at present has five polymerization units, three of which are in the United States. All are operating at capacity levels, but order volume is increasingly heavier, according to Mr. Marusi. The plants in the United States are located in Peabody, Mass., and Illiopolis, Ill., both acquired when American Polymer Corp. joined Borden last year, and in Bainbridge, N. Y., where production of emulsion polymers was begun a few months ago. The other two operations include the former American Polymer units in Toronto, Ont., and Sao Paulo, Brazil.

General Electric Co., Pittsfield, Mass., announces the installation of a complete, semi-continuous compounding system at its phenolic products plant which is expected to provide for a 60% boost in plant capacity over previous production levels. The new system has been designed by G-E engineers and incorporates the most advanced precautions taken for employee safety in the compound manufacturing field.

John L. Galt, plant manager, says that increased plant capacity has been needed to allow for growth in the company's rubber phenolic materials line. New facilities have also been required for production of G-E's improved general-purpose compounds, one-stage molding compounds, and flock flour.

Mr. Galt further states that the new compounding system was specially designed to meet the needs of recently developed automatic molding techniques for high-density powders. The plant is also set up to minimize gas in new compounds, thus promising faster cure and improved surface appearance for the final molded plastics part.

General Aniline & Film Corp. has broken ground for the construction of a new $6 million chemical plant in Calvert City, Ky.

One of the chemicals to be produced is polyvinyl-pyrrolidone—known as P.V.P., a blood volume expander. A considerable quantity of P.V.P. has been manufactured at Linden, N. J., and recently General Aniline produced sufficient P.V.P. to make 500,000 units of the blood volume expander for emergency stockpiling by the Government.

In addition to this use, P.V.P. has been used as a binder, film former, stabilizer, and detoxifier in a fast-growing list of products including hair lacquers, shaving creams, hand lotions, and antibiotic and other pharmaceutical preparations. P.V.P. also has a number of textile uses involving sizing, stripping, and binding of dyestuffs.

Du Pont's Organic Chemicals Dept. plans to construct additional facilities for the manufacture of polyisocyanates at the company's Chambers Works in Deepwater, N. J.

All design and construction work will be conducted by Du Pont's Engineering Dept. and supervised by **J. C. Lang,** the plant's field project manager. Completion of the entire project is scheduled for mid-1956.

Acheson Industries, Inc., 420 Lexington Ave., New York 17, N. Y., is constructing a new plant in Orange, Texas, to supply polyethylene producers with dispersed pigments and carbon black. The plant will be known as **Acheson Dispersed Pigments (Texas) Inc.** and is a corporate subsidiary of Acheson Industries. This will be the fourth unit of Acheson, which includes **Acheson Colloids Ltd.,** Slough, England.

Acheson Dispersed Pigments Co., Philadelphia, Pa., will market for and generally supervise the production of the Orange plant.

Ecusta Paper Corp., a subsidiary of **Olin Mathieson Chemical Corp.,** has started production of polyethylene packaging film and tubing at its newly completed facilities at the Pisgah Forest, N. C., plant, where cellophane is manufactured.

Simultaneously, production of the **Olin Film Div.'s** Dura-Clear polyethylene by the **Harwid Co.** plant in Cambridge, Mass., will be discontinued. Production of both polyethylene and cellophane will now be combined at one location at Pisgah Forest.

Majestic Creations, Inc., 37-03 Woodside Ave., Woodside 77, N. Y., announces the opening of its second plant to meet the heavy demand for its vacuum formed plastics signs and displays.

Sommers Plastic Product Co., 7-9 W. 18th St., New York 11, N. Y., has acquired 7000 sq. ft. of additional warehouse space to facilitate the handling of its novelty plastic sheeting, Fashon, a product of **The General Tire & Rubber Co.** Majestic is General Tire's distributor of Fashon to the handbag, billfold, and allied trades.

Sommers has also formed a Canadian subsidiary, **Sommers Plastics of Canada Ltd.,** 6333 St. Lawrence Blvd., Montreal, Que. **Phil Schechter** will manage the offices and warehouse.

Mycalex Corp. of America, Clifton, N. J., is building a synthetic mica plant in Caldwell Township, N. J., to be operated by **Synthetic Mica Corp.,** a new subsidiary. Mycalex states that the construction of this plant will be the beginning of a new industry which, it is hoped, will eventually reduce United States dependence on India for the highly strategic material.

Jerome Taishoff, president of the parent company, reports that the plant is scheduled to begin production early in 1955. Estimated annual output of the new plant will be 1000 tons of high-grade synthetic mica,

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about 5 to 10% of the nation's current requirement. Synthetic mica is made of raw materials that are plentiful in the United States—aluminum oxide, magnesium oxide, silica sand, a fluoride, and potash feldspar.

COMPANY NOTES

Monsanto Chemical Co. announces the following appointments: **Robert L. Berra** has been named to the newly created post of director of sales training for its **Plastics Div.** in Springfield, Mass. **Howard L. Minckler,** formerly a general manufacturing superintendent of the division, has been appointed plant manager of the Avon, Calif., plant of the company's **Organic Chemicals Div.** Mr. Minckler replaces **Donald J. Miller,** who has been named plant manager of **Mobay Chemical Co.'s** new plant in New Martinsville, W. Va.

National Vulcanized Fibre Co., Wilmington, Del., has appointed a staff for its new $200,000 research and development laboratory at Yorklyn, Del., as follows: **Gerald H. Mains,** formerly laboratory director of the company's **Phenolite Div.,** is now director of the new project; **Alfred J. Green** will assist Mr. Mains as manager; **Frederick L. Stiegler** will be in charge of the Paper and Fibre Section; and **Joseph C. Pesce** will head up the Phenolite Section.

Celanese Corp of America's Plastics Div., 180 Madison Ave., New York 16, N. Y., has added the following personnel: **Frank E. Seborowsky, David M. Bartlett, Gerald J. Monaghan,** and **Fred H. Branstetter** have been assigned to the Sales Dept.; **Paul K. Riske,** to the Technical Sales Service Dept.; and **James J. Begley,** to the Market Development Dept.

Atlas Powder Co., Wilmington 99, Del., announces that **Edward J. Goett** has been elected a director and vice president in charge of the company's Chemicals, Darco, and Commercial Development Depts. Mr. Goett, formerly a director and sales development manager of Chas Pfizer & Co., joined Atlas last July to head up the newly-formed Commercial Development Dept. **W. Clayton Lytle,** previously general manager of Atlas explosives, has been named general manager of the Chemical Dept. He succeeds **Kenneth E. Mulford,** who is now assistant to Mr. Goett.

Synthetic Products Co., 1636 Wayside Rd., Cleveland, Ohio, announces the appointment of the following sales representatives as a result of its expansion program: **H. L. M. Royal Co.,** Los Angeles, Calif.; **Binny & Smith, Ltd.,** Toronto, Ont.; and **Palmer Supply Co.,** Fla. Synthetic Products manufactures over 100 different products for the metallic stearates and vinyl heat and light stabilizer industry under the tradenames of Synpro and Synpron.

National Starch Products, Inc., 270 Madison Ave., New York 16, N. Y., announces that **R. A. Bintz,** manager of its Plainfield, N. J., plant, has been promoted to assistant director of manufacturing; **James L. Edwards,** plant superintendent at Plainfield, succeeds Mr. Bintz as plant manager; and **Russell W. Burdge** has been named plant superintendent.

Bro-Dart Industries, 59 E. Alpine St., Newark 5, N. J., announces that **Advertising Tapes, Inc.,** formerly located at 460 E. 148th St., New York, N. Y., is now a division of the company and has started operations at the Newark address. **Irving Marder** has been appointed sales manager of the division.

Bro-Dart specializes in printing pressure-sensitive tapes, primarily for libraries and schools, and can meet the requirements for any type or brand of tape made of cellophane, acetate fiber, cloth, or paper.

Bradley Container Co., Maynard, Mass., has appointed **Chemical By-Products, Ltd.,** 8 Ripley Ave., Toronto, Ont., as its Canadian sales agent.

Respro Inc., Cranton, R. I., has acquired the facilities of **Lion Leather & Plastic Co.** and **Pilgrim Plastic Leather Co.,** both in Beverly, Mass. The acquired companies have been merged into a new corporation known as **Lion Products Co.,** which will operate as a wholly-owned subsidiary of Respro. Lion Products will be New England distributor of Respro's line of plastics film and sheeting and will also specialize in embossings and finishes for the handbag, shoe, belt, novelty, and upholstery trades.

Raymond S. Newell, president of Respro, states that the entire personnel of the acquired companies will remain with the new company. **Nathan Cohen,** formerly president and treasurer, will continue as general manager of Lion Products, with **Horace Strauss** as his assistant. Mr. Newell is now president and treasurer; **Morris Krachman,** assistant treasurer; and **Leonard J. Carey,** secretary.

The Mounty Co., 600 Commercial Trust Bldg., Philadelphia 2, Pa., is a new sales organization which will represent manufacturers of plastics packaging and premium items in the Philadelphia and Delaware Valley areas.

The Stanley Chemical Co., East Berlin, Conn., announces the appointment of **Russ-Howell Agency,** 823 28th St., S. W., Grand Rapids, Mich., as distributor of the company's plastisols and organosols in Michigan, Ohio, Indiana, Illinois, and Wisconsin. Russ-Howell also has a branch office at 17184 E. Warren Ave., Detroit, Mich.

Alsynite Co. of America, 4654 De Soto St., San Diego 9, Calif., has added the following representatives to its sales staff: **Gerald D. Griffin** has been named district manager and will cover the southern states, with offices at 2 Collier Rd., Atlanta, Ga.; **Will Thomas** is now district manager for the New York and New England area, with headquarters at Alsynite's new eastern plant at 300 E. 18th St., Paterson, N. J.; **Richard J. Miller** will cover southern California and Arizona from his new office at 2624 Crenshaw Blvd., Los Angeles, Calif.; and **Harold J. McDonnell** has been appointed Canadian representative, with offices at 372 Bay St., Toronto, Ont.

Simon Adhesive Products Corp., 424 W. 33rd St., New York, N. Y., manufacturer of Eze-Stik, announces that **Al Berk** has been named vice president and technical director of the company and **John R. Orlando,** former general manager, has been

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appointed vice president. Mr. Berk was previously connected with Paisley Products, Inc., as a research chemist.

Plastic Laminating Co. has moved its plant and office to Wallingford Rd., south of Baltimore Pike, Swarthmore, Pa.

Architectural Plastics Corp., Eugene, Ore., has been recently formed and will take over the wholesale and brokerage activities of **Plasti-Products Co.**, a specialized organization serving plastics materials of interest to architecture and the building industry. **George R. Hermach**, founder of Plasti-Products, is president of the new firm.

United States Rubber Co., Rockefeller Center, New York 20, N. Y., has appointed **Edmund G. Nagle** sales manager of manufacturers' products for the Footwear and General Products Div. He will be responsible for products sold directly to manufacturers and allied customers, including foam rubber for transportation uses and for home furniture, automotive mats, Royalite plastics products, and sponge products. Mr. Nagle will make his headquarters in the company's Mishawaka, Ind., plant.

Bright Star Industries, 600 Getty Ave., Clifton, N. J., announces that it will now accept custom molding of plastics for its injection molding department. The company has a completely integrated service from making the molds in its own shops through the molding and finishing operations; 15 available injection presses range from 2 to 16 oz. in capacity.

Martin S. Wohl has joined the sales staff and will handle technical sales for the firm's newly expanded facilities.

United States Plywood Corp., 55 W. 44th St., New York 36, N. Y., has acquired 100% ownership of the Flexwood and Kalistron manufacturing and sales operations.. These operations were formerly conducted with **The Mengel Co.** and other firms. The consolidation, together with expanded production facilities and a stepped-up sales program, are the basis for U. S. Plywood forming a product section to be known as the Flexible Materials Div. which will produce and market Kalistron, Kalitex, Flexwood, and Randomwood.

Kalistron is a leather-grained vinyl sheeting. Kalitex, a material of lighter weight and with a basket weave, is of the same construction as Kalistron. Flexwood is a natural wood veneer, 1/85 of an inch thick and bonded to a specially woven cotton backing. Randomwood is similar to Flexwood, except that the sheets do not have matching grains.

A new plant has been opened for the new division in Louisville, Ky. **Charles L. Westray**, a veteran in the veneer industry, has been named to head all production. Sales headquarters in New York will be supervised by **Warren E. Poitras**, sales manager, with **L. B. Goodnough** in charge of the upholstery section.

Harte & Co., Inc. has moved its offices to 16 E. 34th St., New York, N. Y. The move from the company's original headquarters at 267 Fifth Ave., established over 20 years ago, follows a steady expansion in the company's history.

The firm's vinyls, tradenamed Wataseal, are calendered, printed, and embossed at its Brooklyn, N. Y., plant. Plicose polyethylene is produced at another plant by **Plicose Mfg. Co.**, a subsidiary of Harte. An office and warehouse in Los Angeles, Calif., are also maintained by Harte.

J. P. Stevens & Co., 1460 Broadway, New York, N. Y., has appointed **Kirby Industries**, Azusa, Calif., as national sales agents for its industrial fibrous glass fabrics. Kirby Industries have been connected with the fibrous glass industry since the company was organized in 1947. **Herbert R. Kirby**, president, was formerly associated with Owens-Corning Fiberglas Corp.

Cast Optics Corp. has moved its facilities from Riverside, Conn., to 123 Newman St., Hackensack, N. J.

Lester Engineering Co., 2711 Church Ave., Cleveland 13, Ohio, has purchased **Phoenix Machine Co.** As a result, engineering, production, and sales are now integrated under the same management. **Lester-Phoenix, Inc.**, 2621 Church Ave., Cleveland 13, Ohio, sales agency for the company, will continue under the same name as a wholly-owned subsidiary.

Officers of both Lester Engineering and Lester-Phoenix are as follows: **David White**, president; **David J. Sloane**, vice president; **Henry A. Rocker**, secretary and treasurer; and **William H. Schwartz**, chief engineer.

PERSONAL

James E. Sayre has been named manager of the **Marketing Research Dept., Barrett Div., Allied Chemical & Dye Corp.**, 40 Rector St., New York 6, N. Y. A Barrett economist since 1939, Mr. Sayre is well known for economic studies published in various chemical journals on coal chemicals.

H. B. (Herb) Ellefson has been appointed central and southwest representative of **Furane Plastics, Inc.**, 4516 Brazil St., Los Angeles 39, Calif., for the sale of the company's Epocast resins and formulations.

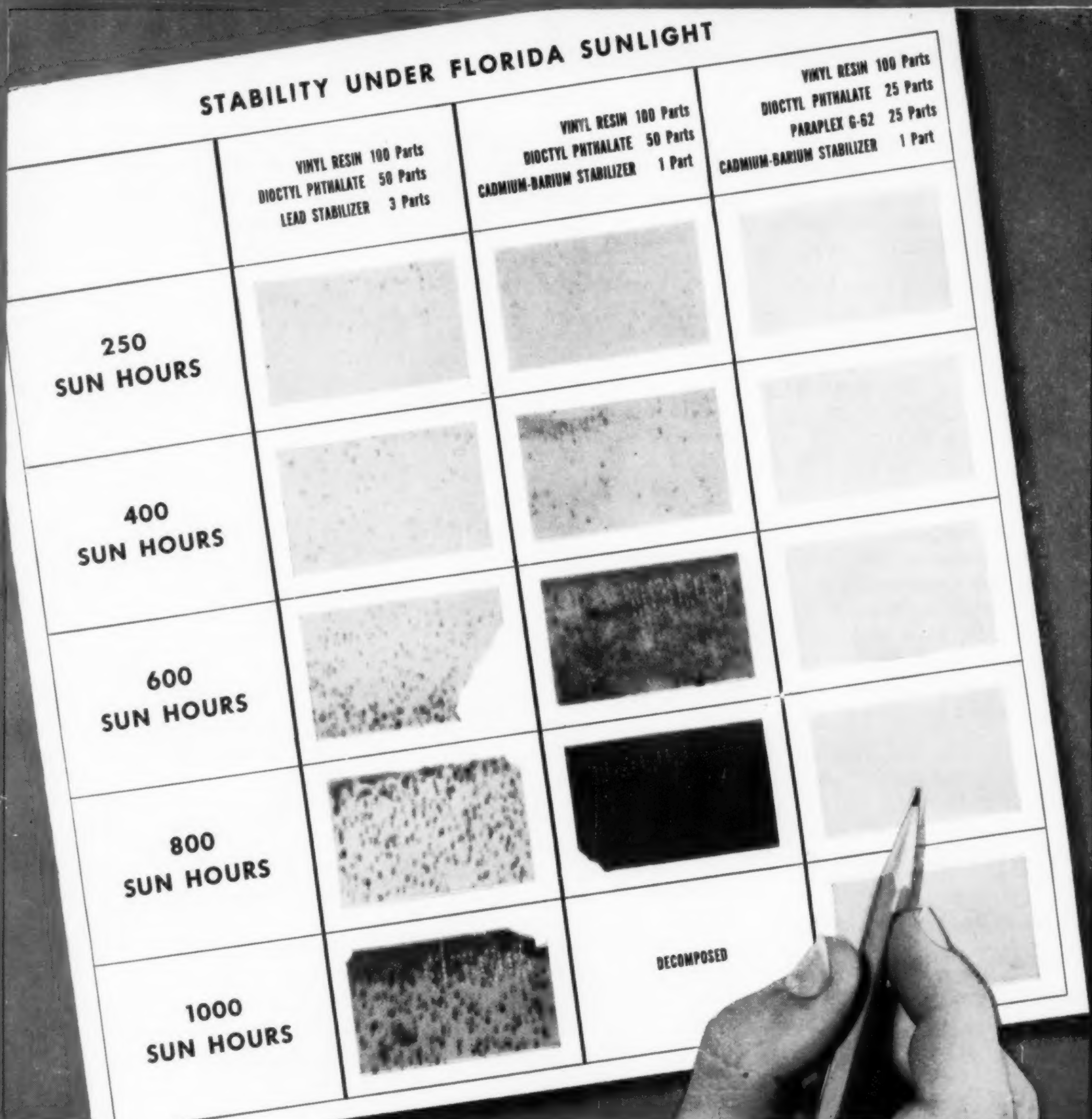
A. T. Olsson has been appointed assistant sales manager of **Acheson Colloids Co.**, Port Huron, Mich. Mr. Olsson, formerly service engineer with offices in Detroit, has recently served in Acheson's main offices in Port Huron.

Cortes E. Hicks has joined **Sinclair & Valentine Co.'s Rubber and Plastic Color Div.**, Ridgway Pa., as plant manager of the division. The division produces rubber and plastics dispersed colors which are sold by **Harwick Standard Chemical Co.**

Patrick J. Deluhery has been appointed general sales manager of **Admiral Corp.'s Molded Products Div.**, 3800 Cortland St., Chicago 47, Ill. The division produces custom moldings of plastics and reinforced plastics.

Clifford E. Otto has been named district sales manager for the New York metropolitan area for **Manco Products, Inc.**, with offices at 520 Fifth Ave., New York 36, N. Y.

W. C. Davis has been appointed Detroit district manager of **Pennsylvania Industrial Chemical Corp.**, Clairton, Pa., and will represent the company in Ohio, Kentucky, and



Florida Sun Proves Value of Paraplex G-62

The stabilizing effect of PARAPLEX G-62 in vinyl compounds was dramatically demonstrated during recent tests under intense Florida sunlight. The samples shown here were exposed for periods ranging up to 1000 sun hours. The improvement imparted by PARAPLEX G-62 is clearly shown by the exposed samples.

In other tests in the field, as well as by Weather-Ometer, Fade-Ometer, and 450°F. oven tests, the results were similar: outstanding resistance to embrittlement and discoloration when PARAPLEX G-62 plasticizer-stabilizer was used.

PARAPLEX G-62 polymeric-type plasticizer also permits fast calendering and low stabilization costs. It provides uniform color and excellent permanence.

Write for "What You Should Know About the PARAPLEX and MONOPLEX Plasticizers", a handy summary of properties and applications.

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parts of Indiana and Michigan. Mr. Davis was formerly associated with Monsanto Chemical Co. as manager of surface coating sales and with American Cyanamid Co.

Peter Muller-Munk of **Peter Muller-Munk Associates,** Pittsburgh, Pa., has been elected president of the Society of Industrial Designers, 48 E. 49th St., New York, N. Y. He succeeds **Robert H. Hose** of Henry Dreyfus, New York, N. Y., who is now chairman of the board of directors.

Frank W. Milward has been named special representative in the Chicago territory of **The Goodyear Tire & Rubber Co.'s Chemical Div.,** Akron 16, Ohio. Mr. Milward will assist in sales and applications of high-impact-resistant molding resins and special vinyl resins.

Dr. Wesley S. Coe has been appointed assistant to **John E. Caskey,** vice president and general manager of **United States Rubber Co.'s Naugatuck Chemical Div.,** Naugatuck, Conn.

S. W. Jones, Jr. has been named administrative manager of sales of **The M. W. Kellogg Co.'s Chemical Manufacturing Div.,** Jersey City 3, N. J. For the past four years, Mr. Jones has been engaged in the sale and promotion of the company's Kel-F polymer products. Prior to joining Kellogg in 1950, he was assistant to the general manager of MODERN PLASTICS and *Modern Packaging* magazines.

Dominick Rosato has joined **United States Asbestos Div., Raybestos-Manhattan, Inc.,** Manheim, Pa., as field engineer and will engage in the development of asbestos base laminates. Mr. Rosato was formerly chief of the Plastics Productions Section of the Materials Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio.

D. Saunders Threlkeld is now manager of the research and control laboratories of **Clopay Corp.,** Clopay Sq., Cincinnati, Ohio. Mr. Threlkeld is experienced in the field of vinyl plastics as well as organic coatings and finishes. He succeeds Philip H. Rhodes who recently left the company to enter the consulting field.

Robert S. First has been transferred from the **Chemical Div. of Celanese Corp. of America,** 180 Madison Ave., New York 16, N. Y., to the **Plastics Div.** as market research manager. Mr. First is now serving as vice president of the Chemical Engineers of Greater New York.

Dr. A. R. Powell, who has been associate manager of the central research department of **Koppers Co., Inc.,** Pittsburgh 19, Pa., since 1949, has been named acting manager of that department following the resignation of **Dr. G. F. D'Alelio.** Dr. D'Alelio, who has managed Koppers research since 1949, will remain with the company for the time being to carry out a special project on high-impact material.

Walter F. Hugger has been appointed general sales manager of **Sun Chemical Corp.'s Electro-Technical Products Div.,** Nutley, N. J. In addition to a complete line of insulating materials for electrical and electronic equipment, the division manufactures Sunform, a polyester-impregnated fibrous glass material available in cloth and mat form.

Kenneth B. Turner is now technical director of **Cook Electric Co.'s Plymold Div.,** 2710 N. Southport Ave., Chicago 14, Ill. Mr. Turner has been engaged in production work with molded plastics laminates for the past 12 years. He was previously senior plastics engineer at Brunswick-Balke-Collender Co.

Dr. Malcolm M. Renfrew has been named director of research and development of **Spencer Kellogg & Sons, Inc.,** 98 Delaware Ave., Buffalo, N. Y. He was formerly connected with Du Pont and General Mills, Inc.

B. Y. Auger has been named general supervisor of **Minnesota Mining & Mfg. Co.'s** "Scotchply" Plastic Development Group of 3M's Tape Div., 900 Fauquier St., St. Paul 6, Minn. Mr. Auger will be responsible for all functions of the group relating to product research, experimental production, and market development for 3M's new "Scotchply" reinforced plastics.

Martin L. Boraz has been appointed executive sales manager of **International Rubber & Plastics Co.'s Plastics Div.,** 521 Spruce St., St. Louis 2, Mo. Mr. Boraz will handle scrap vinyls and other thermoplastic materials.

MEETINGS

Jan. 13-20—National Housewares Manufacturers Association, National Housewares Exhibit, Navy Pier and Drill Hall, Chicago, Ill.

Jan. 18-28—Provincial Exhibitions Ltd. and Institute of Packaging, Britain's Fourth International Packaging Exhibition, National and Empire Halls, Olympia, London, England.

Jan. 20-21—The Chemical Market Research Association and Commercial Chemical Development Association, Joint Meeting, Edgewater Beach Hotel, Chicago, Ill.

Feb. 8-10—Society of the Plastics Industry, Inc., Tenth Annual S.P.I. Reinforced Plastics Division Conference, Hotel Statler, Los Angeles, Calif.

Feb. 22-23—The Society of the Plastics Industry (Canada), Inc., Thirteenth Annual S.P.I. Canadian Conference, Hotel London, London, Ont.

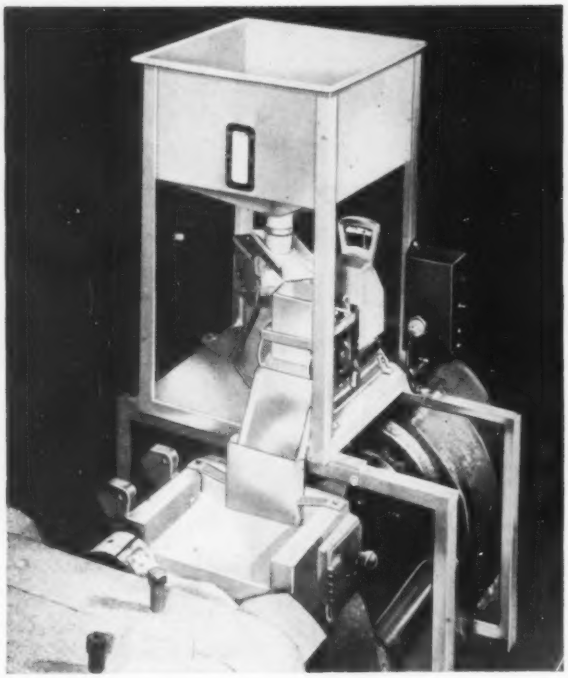
April 4-7—American Chemical Society, Div. of Paint, Plastics, and Printing Ink Chemistry, Meeting, Cincinnati, Ohio.

April 6-10—World Plastics and Trade Exposition, National Guard Armory in Exposition Park, Los Angeles, Calif.

May 7-15—The Society of the Plastics Industry, Inc., 1955 Annual Conference, Convention Cruise Aboard *Queen of Bermuda* to Havana, Cuba, and Nassau, B.W.I.

S.P.E.

Jan. 19-21—The Society of Plastics Engineers, Inc., Eleventh Technical S.P.E. Conference, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.



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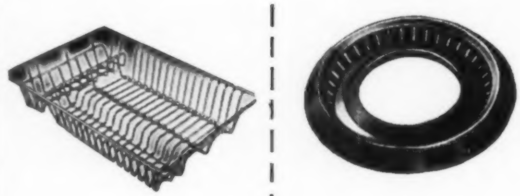

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HYDRAULIC PRESSES: 1—Erie Belt Press, 4242 Tons, 2—8″ openings, 18′-0″x52″ steel steam platens, 6 rams—30″ diam. x16″ stroke; 1—Birdsboro, 2000 Tons, down-acting ram 34″ diam. x14″ stroke, 48″ DLO, 42″x42″ bed area; 1—Farrell, 1000 Tons, 2—6″ openings, 42″x42″ Steel Steam platens, ram 36″ diam. x12″ stroke; 1—HPM, 750 Tons, down-acting, ram 28″ diam. x43″ stroke, 72″ DLO, 59″x44″ bed area, MD Low and High Pressure Pumps and Accumulator System; 1—Erie, 700 Tons, 2—7″ openings, 38″x38″ steel steam platens, ram 30″ diam. x17″ stroke. 1—Baldwin-Southward, 400 Tons, slab-side, 30″x30″ steel steam platens, 23″ DLO, ram 21″x17″ stroke; 1—Farrell, 393 Tons, 48″x48″ steam platens, 2—15″ openings, 4 rams 10″ diam. x24″ stroke, approx. 15″ per opening; 1—Farrell, 200 Tons, 2—6″ openings, 36″x36″ steel steam platens, ram 16″ diam. x11″ stroke; 1—Watson-Stillman, 100 Tons, down-acting ram 11½″x9½″ x6″ stroke, 22″x20″ bed, 24″ DLO, self-contained, 15 HP MD Vickers Pump. Unit practically new; 1—Watson-Stillman, 100 Tons, 11¾″x12″ platens, 22½″ DLO, ram—8″ diam. x15″ stroke, complete with 3 HP MD pump; 1—HPM, 100 Tons, 18″x18″ platen area, ram—8″ diam. x18″ stroke, 30″ DLO, steel cylinder—4000 PSI; 1—HPM, 35 Tons, down-acting ram 6″ diam. x6″ stroke, 15″ DLO, 12″x6″ bed area, self-contained; 2—Watson-Stillman Laboratory, 30 Tons, 6½″x 9½″ electrically heated platens, integral hand pumps. INJECTION MOLDING MACHINES: 1—Plasticor Vertical 2 oz; 1—HPM Horizontal Model 54, 2 oz; 2—Reed-Prentice, 2 oz; 1—Watson-Stillman, 2 oz., Frame suitable up to 6 oz; 2—Lester, 4 oz. 2—HPM Model 200-H, 9 oz; 1—Lester, 12 oz; 2—Impco Model VF-822A, 22 oz. EXTRUSION MACHINES: 1—MPM, 1951, 3HP Sterling Speed-Trol Drive; 2—MPM, 1951, 40 HP M.D.; 1—MPM Pelletizer, 95% New, Capacity up to 1000 lbs. per hour; 1—Royle No. 1, Rubber, 5 HP M.D.; MIXERS: Baker-Perkins, Lab Size 6, Class BB, Stainless Steel Sigma Blades Jacketed Body, arranged for Motor Drive Banbury No. 1, Completely Chrome Plated Interior for Plastics, 50 HP Motor Drive, Oil Heating System. All Controls; 1—Ball & Jewell Midget, Stainless Steel, 1 HP M.D. Rotary Cutter. Other sizes and makes of Plastics and Rubber Extruders; also Mills, Calenders, Mixers, Grinders, Pumps, Valves, Platens, etc. JOHNSON MACHINERY COMPANY, 683 P Frelinghuysen Avenue, Newark 5, New Jersey. Tel: Bigelow 8-2500. What have you for sale? What are you looking for?

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550 Ton Hydraulic Platen Press: 10 openings, 11 platens, 41x44x2¼, 2¾″ daylight between platens, 20″ ram upward acting. Power pack with 20 HP 220/440 3 phase 60 cycles motor, Racine 30 gallon/minute variable delivery pump and Racine 7:1 booster. With full automatic electronic timer controlling and recording heating, cooling and hydraulic cycles. Complete with hydraulic elevator to load and unload press. ALSO—Conveyorized Infra Red Oven: 168 KW, 48″ Canvas Belt Conveyor, 10-75 ft. per min. variable speed, with 4 Gun Binks Reciprocator Unit and Pressure Laminating Roll. 440 V, 3 phase Input with all exhaust and circulating blowers complete with stacks. For spray painting or adhesive bonding of plastic or metal sheet to wood.
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FOR SALE: One National Research High Vacuum Coating Machine 48″ with all necessary equipment to go with it. Excellent condition, large pumps, booster, inside mechanism, filament bars. Reply Box 10255, Modern Plastics.

KUX 2½″ dia. Single Punch Preform Machine. Leominster 8 oz. Injection Molding Machine complete late type. Plastic and Rubber Equipment. Farrell 16″x48″, 15″x36″ and 6″x12″, 2 roll mills. Mills and Calenders up to 84″. New Seco 6″x12″ and 6″x16″ Lab. Mixing Mills and Calenders. Rubber & Plastic Extruders. 200 ton Hobbing Press 18″x14″ platens. HPM 200 ton 30″x48″ Platens. New Loomis 340 ton, 24″x56″ platens. 200 ton Brunswick 21″x21″ Platens, 14″ Ram. Southwark 30 ton 14″x14″ platens, semi-auto. Elmes 75 ton 30″x36″. Also Lab. to 2000 tons from 12″x12″ to 48″x48″ Hydr. Oil Pumps. Gould 75 HP motor Dr. 2 stage Centrif. Pump 250#. W. S. 4 Plgr. High and Low Pressure Hydr. Pump. Elmes Hor. 4 Plgr. 4500 lbs. and 5500 lbs., Hydr. Accumulators. Stokes Automatic. Molding Presses. Rotary & Single Punch Preform Tablet Machine ½″ to 4″. Injection Molding Machines 1 oz. to 32 oz. Baker Perkins Jacketed Mixers. Plastic Grinders. Heavy duty mixers, gas boilers. Partial listing. We buy your surplus machinery. STEIN EQUIPMENT CO., 107-8th Street, Brooklyn 15, N.Y. STerling 8-1944.

FOR SALE: 1—F.B. 32″x92″ inverted-L 4 Roll Calender, reduction drive, d.c. vari-speed motor; 1—Royle #4 Extruder, motor driven. 1—6″x12″ Laboratory Mill, m.d. 1—Ball & Jewell #2 Rotary Cutter, 15 h.p. motor. 3—#28 Devine Vac. Shelf Dryers, 19—59″x78″ shelves, complete. 1—Farrell-Birmingham 6″x13″ 3 Roll Calender. 3—Colton #5½ single punch Cabot machines, m.d. 1—Read-Standard 2000 lb. steel horizontal mixer. 1—Farrel 20″x22″x60″ mill, top cap frame, falk reduction drive, 100 h.p. motor. 2—Farrel 16″x42″ Mills with reduction drive and 100 h.p. motor. 4—Hymac 125 ton Molding Presses. 16″x16″ electrically heated platens. Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425. N. Y. Tel.: BArclay 7-0600.

FOR SALE: Hobbing Press 800 Ton W.S. (2) 300 Ton W.S. Presses 20x20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen Ball & Jewell Plastic Grinders. Standard Mystic Embossing Presses. Accumulators, Pumps, Valves. Many other Presses—Send For Bulletin. AARON MACHINERY CO., INC., 45 Crosby St., New York 12, N. Y. Tel. WAlker 5-8300.

SAVE WITH GUARANTEED REBUILT EQUIPMENT: 2 New R. D. Wood 500 ton embossing presses; 54″x26″ platen, HYDRAULIC PRESSES: 40″x40″, 36″ ram, 1500 tons; 2—27″x27″, 18″ rams, 585 tons; 20″x20″ 10″ ram, 200 tons; 20″x20″, 14″ ram, 200 tons; 15″x15″ 8″ ram, 75 tons; 14″x14″ 8″ ram, 75 tons; 2—19″x24″ 10″ rams 78 tons; 18″x18″, 7″ ram, 50 tons; 10—26″x26″ 7″ rams, 50 tons; 12″x12″ 7½″ ram, 50 tons; 14″x14″ 8″ ram, 50 tons; 8″x9½″ 4½″ rams 20 tons; 16″x16″ 3½″ rams, 12 tons; Carver model 150 and 6″x 6″ LABORATORY PRESSES; Stokes Model T, late type with drive; Stokes Model T, late type with hydraulic equalizer system and drive; Colton 5½T with drive PREFORM PRESSES; NEW UNIVERSAL DUAL PUMPING UNITS 3—15 HP; NEW LABORATORY MILLS and CALENDERS; HPM 6″ ram, 2500# pressure ACCUMULATOR; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. UNIVERSAL HYDRAULIC MACHINERY COMPANY, INC., 285 Hudson Street, New York 13, N.Y.

FOR SALE: Stainless Steel Rotary Dryer, Link Belt Co., 5′2″x16′, No. 502-16, with all auxiliary equipemnt. Roto Louvre type. Reply Box 13855, Modern Plastics.

FOR SALE: 60 oz. H.P.M. 48 oz. Lester, $45,000. 48 oz. DeMattia, new 20 oz. Lester, new 1950, $16,000. 16 oz. H.P.M., 1952 16 oz. Reed-Prentice, 1953. 12 oz. Lester, 1946, $7,000. 12 oz. Crown Moldmaster, $10,500. 12 oz. Watson-Stillman, excellent. 9 oz. H.P.M., $5,500. 8 oz. Fellows, 1948, $7,500. 8 oz. Reed-Prentice, double link, $6,000. 8 oz. Lester, 1949, $7,500. 8 oz. Leominster, $5,000. 6 oz. Reed-Prentice, $3,500. 6 oz. Lester, $4,000. 4 oz. Reed-Prentice, 1949, $4,750. 4 oz. Lester, 1949, $5,500. 4 oz. Impco, $8,000. 4 oz. Lester, $3,000. 4 oz. Lester vertical, $4,500. 3 oz. Fellows, $6,500. 2 oz. Watson-Stillman vert. almost new. Ball & Jewell/Cumberland scrap grinders. 6 Tray Preheating ovens, $150. each. #235-A Stokes press. 80 ton Transfer & Compression press, brand new, $4,250. 3″ cap. Extruder. New Italian make extruders. ACME MACHINERY & MANUFACTURING CO., 102 Grove Street, Worcester, Mass.

AVAILABLE AT BARGAIN PRICES
Colton 2RP and 3RP Rotary & #5½ Tablet Machines. Rotex, Tyler Hum-mer, Selectro, Robinson, Raymond, Grayco, Great Western Sifters. Mitts & Merrill 15CD Rotary Cutter. Mikro Bantam, 1SH, 2TH, 3W, 4TH Pulverizers. Baker Perkins Heavy Duty Steam Jacketed, Double Arm, from 5 to 200 gal., Mixers (Unidor and Vacuum also). J. H. Day, from ¾ up to 100 gal., Imperial and Cincinnatus D. A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Gemco 2000 lb. Double Cone Blender. Package Machy. FA, FA2, FA4, U4, Miller, Hayssen, Wrap-King, Scandia, Oliver Auto. Wrappers—all sizes. REBUILT AND GUARANTEED—This is only partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements. UNION STANDARD EQUIPMENT CO., 318-322 Lafayette St., New York 12, N.Y.

1—STOKES 200 Ton, Hydraulic, Single Punch Press 10″x6″ preform x5″ depth of fill. 1—National 10″x20″ two roll Mill with 25 HP motor; 1—Baker Perkins 100 gal. S.S. double arm jacketed Vacuum Mixer; 2—Baker Perkins, Readco 100 gal. Jacketed double arm Mixers; 1—Baker Perkins 50 gal. double arm jacketed Mixer 50 HP motor; 4—Stokes Rotary Preform Presses DD2, DDS2, D4 and D3; 1—Kux Model 15-25 double action Rotary Press; Also: Sifters, Cutters, Banbury Mixers, etc., partial listing; write for details; we purchase your surplus equipment. BRILL EQUIPMENT CO., 2407 Third Ave., New York 51, N.Y.

---

(5) NEW WATSON-STILLMAN EJECTION Molding Heating Chambers, one four ounce, one six ounce, two eight ounce, one sixteen ounce. Price one third the cost of new. New 75 ton presses, size 22x22, 10″ ram, 10″ stroke, $1100 each, ten day delivery f.o.b. Brooklyn, New York, one or more can be obtained. HYDRAULIC SAL-PRESS CO., INC., 388 Warren Street, Bklyn., N. Y.

FOR SALE: 1 Stokes R4 Preform Press; 1 Colton 5½T Preform Press; 3 Ball & Jewell, Cumberland Cutters 1-20 HP; 1 Stokes Windsor R1400 Extruder; also Mixers, Presses, Mills, etc. CHEMICAL & PROCESS MACHINERY CORP., 146 Grand Street, New York 13, N. Y.

IMPCO COMPRESSION and Injection Machine 22 oz. Built 1946. Very reasonably priced. AARON MACHINERY CO., 45 Crosby St., New York, N.Y. WAlker 5-8300.

(Continued on page 242)

CLASSIFIED ADVERTISING

(*Continued from page 240*)

FOR SALE: One 1945 Model 24 W 500 Watson Stillman Injection Molding Machine. Complete with: Two 24 oz. and one 18 oz. Cylinder. Good operating condition & may be inspected in our plant by appointment. NATIONAL PRODUCTS COMPANY, 6100 Wilson Road, Kansas City, Missouri.

FOR SALE: Injection Presses: 4, 8, 12, 16, 22, 32 oz. Reed, 8, 12 oz. Lester, 9, 16, 40 oz. HPM, 1 oz. VanDorn. —2½" Extruder. Extruder Conveyors. Small & large Scrap grinders, Ovens. Compression & Transfer presses: 50, 100, 250 & 500 tons. —Preform presses: Stokes R 4, 280 C. —42" Slitt. & Rewind machine—3HP Gas boilers. Big Fiberglas press & Oven. Equipment to be inspected in operation in Midwest. List surplus equipment with me. JUSTIN ZENNER, 823 Waveland Ave., Chicago 13, Ill.

MACHINERY and EQUIPMENT WANTED

WANTED—Transfer molding press, 200 or 300 ton. Regular, or Impco type. Must be in perfect operating condition. State price and year. MORSKIL CO., 415 Lexington Ave., New York, N. Y.

WANTED: Madison-Kipp, Model #5 or similar size Diecasting machine, to cast lead base alloys. State price, location, serial number and condition. Reply Box 11255, Modern Plastics.

REQUIRE F. J. Stokes #252 Automatic Closure Molding Press, 50 to 150 tons and Single Punch Rotary Tablet Presses, and Banbury Mixers. Please advise full particulars, price. Box #11455, Modern Plastics.

WANTED: One used NRM electrically heated plastic extruder, 3½ or 2½. Must be in good operating condition. Please describe condition, type of screw, and furnish price in reply. Reply Box 12455, Modern Plastics.

WANTED
32 ounce late model Watson Stillman or H.P.M. Injection Molding Machine. Reply Box 13455, Modern Plastics.

WANTED: Machinery including Rubber Mills, Hydraulic presses, Study mixers, Calenders, Banbury mixers, Pulverizers, Grinders, Rotary cutters, Extruders, Screens, Injection Molding machines, Dryers. Will purchase complete plant. CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N.J. HOboken 3-4425. N. Y. Tel.: BArclay 7-0600.

WANTED—Used Presses, 30" x 54" minimum Platen, 500 ton minimum pressure—prefer french oil, advise price, make, condition, etc. Reply Box 10955, Modern Plastics.

WANTED: 8 oz. Injection Molding Machine. No. 3 Banbury Mixer, Calender, Extruder. Give particulars. Reply Box 13955, Modern Plastics.

MATERIALS FOR SALE

FOR SALE: 20,000 lbs. Reprocessed Butyrate Pellets, bright colors; 30,000 lbs. Mahogany Mottle Reprocessed Acetate Pellets originally made for toy gun stocks. Priced very low. 20,000 lbs. Virgin Mother-of-Pearl Polystyrene, various colors; 15,000 lbs. 65 durometer Red Vinyl Pellets. Large variety Bright Colors Acetate Pellets. All at low prices. Samples on request. A. BAMBERGER CORPORATION, 703 Bedford Avenue, Brooklyn, N. Y., Telephone MAin 5-7450.

FOR SALE: 20,000 lbs. each Red and Blue Styrene Pellets. Surplus lot Red Acetate Pellets—15,000 lbs. Both attractively priced. We are also in the market for all surplus plastic scrap and powder. FRANKLIN JEFFREY CORPORATION, 2004 MacDonald Avenue, Bklyn., N. Y. Tel.: ES 5-7943.

MATERIALS WANTED

WANTED: Plastics Scrap and Rejects of all kinds, ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid. A. BAMBERGER CORPORATION, 703 Bedford Avenue, Brooklyn 6, N.Y., Telephone MAin 5-7450.

SCRAP PLASTICS, all forms, waste and surplus plastic molding materials, rejects in any form. We will also buy your obsolete inventories of molding powders, stabilizers, plasticizers and other plastic and chemical materials. ACETO CHEMICAL CO., INC., 40-40A Lawrence St., Flushing 54, N.Y. INdependence 1-4100.

SELL US YOUR PLASTIC SCRAP. Polyethylene, Polystyrene, Acetate, Ethyl Cellulose, Acrylics, Butyrate, Nylon. GEORGE WOLOCH, Inc., 82 Beaver St., New York 5, N. Y.

INTERESTED IN PURCHASING odd lots of resin and off resin. Any quantity, large quantities preferred. Reply in detail sending samples and identify material offered. Reply Box 13355, Modern Plastics.

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. DUKE PLASTICS CORP., 406 Atlantic Ave., Bklyn. 17, N.Y. ULster 8-9413.

HELP WANTED

EASTERN PLASTIC MATERIALS Manufacfacturer wants: 1) Chemist or Chemical Engineer experienced with color concentrates, color matching and Thermoplastic compounding. 2) Foreman experienced with mills, extruders and Banbury. 3) Salesmen for both Eastern and Middle Western territories. Send complete resumes stating salary required. Reply Box 13055, Modern Plastics.

PLASTICS EXECUTIVES—$5,000 to $25,000. We have immediate openings with leading national concerns for competent men in all phases of the Plastics industry. Rapid, confidential, nationwide service. For application, send your name and address to: E. B. Shea, Plastics Industry Division, DRAKE ENGINEERING PERSONNEL, 7 West Madison Street, Chicago 2, Illinois.

PLASTICS ENGINEER
Major supplier of thermoplastic coated wire and cable has an exceptional opportunity for a plastics engineer with experience in compound formulation, blending and fabrication. Must be familiar with all types of compounding materials and with extrusion techniques. Applicants should preferably have a degree in chemistry. This is not temporary work. Plant is located in lower Michigan. Reply, stating age, education, experience and salary requirements. Reply Box 11755, Modern Plastics.

DIRECTOR FOR RESEARCH AND PRODUCT DEVELOPMENT. Rapidly expanding plastics firm in Chicago area desires man preferably with degree in mechanical engineering to direct Research and Product Development Department. Good knowledge of the chemistry of thermoplastics as applied to injection molding, extrusion, and vacuum forming desirable. Must have creative ability and good background of experience in connection with the plastics industry and capable of customer contact. Submit complete resume and salary requirements to R. J. Olson, FEDERAL TOOL CORPORATION, 3600 W. Pratt Blvd., Chicago 45, Illinois.

PLASTICS, INJECTION MOLDING FOREMAN for steady part time work in small midtown New York City shop now being organized. Reply Box 11855, Modern Plastics.

PLASTIC SHEET EXTRUSION SUPERINTENDENT: We have an excellent opportunity for a man with a good experience background in high impact polystyrene sheet extrusion. Vacuum forming experience also helpful. This position is with a new corporation in a new plant with new equipment in the Chicago area. All replies held in strictest confidence. Reply Box 10855, Modern Plastics.

VINYL FILM & SHEETING PRODUCTION MAN with considerable laboratory & calendering experience. Reply Box 11955, Modern Plastics.

A YOUNG AGGRESSIVE COMPANY with proven record located in the Middle South Atlantic States wishes to establish a Plastics Moulding Division. We need an aggressive, competent man to head this Division. An excellent opportunity for a man who wants to get ahead in his field. Send resume of qualifications, experience, and salary expected. Reply Box 10355, Modern Plastics.

CHEMIST—Well established plastics extrusion company, located in metropolitan New York area, seeks young graduate chemist out of school a year or two for introduction into our research and development program on thermoplastics. High potentialities for growth more interesting than type and amount of experience. To receive prompt and careful consideration give full information regarding experience, education and salary requirements in first letter. Box 11055, Modern Plastics.

ENGINEER—1953 or later M.E or ChE graduate. Some experience with equipment for extrusion of thermoplastics desirable, but growth possibilities for young, promising engineer with a liking for research more interesting to us than experience. Aggressive, well established company located near New York City. Send resume including personal and experience data with salary requirements for prompt consideration. Reply Box 11155, Modern Plastics.

(*Continued on page 244*)

CLASSIFIED ADVERTISING

(Continued from page 242)

SALES DEVELOPMENT. Excellent opportunity in sales development and technical service of polyethylene. Experience required in techniques of producing film, sheeting, wire coating, and pipe. Position will require traveling. Kindly include full details of experience, education, personal data, and salary requirements in first letter. Reply Box 10455, Modern Plastics.

WHERE IS THE INJECTION MOLDING ENGINEER who can fit this job? He has a terrific future with us, but he must have: Energy & Resourcefulness to see a job through no matter what obstacles stand in the way. The job comes first—regardless of the time. Intelligence & Superior Mechanical Ability—Must be willing to get his hands dirty. Technical Knowledge in all phases of injection molding: time study; setting cycles; quotation work, including calculating volumes from blueprints; finishing; painting and assembly operation; inspection and quality control. Leadership—Knows how to bring out the best in people to get the job done. Our plant is growing very rapidly. We are located in Virginia. You have an opportunity to grow with us as a key man with profit participation, but you have to be really good to qualify. Salary will be attractive. Write in confidence—President. Reply Box 10555, Modern Plastics.

INJECTION MOLDING SHIFT FOREMAN. Capable of supervision of men, quality control, and maintenance of equipment in a custom molding shop with fifteen presses. Must have molding knowledge of all thermoplastic materials, and must be equipped to handle the every-day problems of economy production. Reply Box 13555, Modern Plastics.

SALES MANAGER
Mid-West Laminator and Fabricator of phenol-fibre products offers position with opportunities to a qualified man. We prefer a seasoned though comparatively young man of executive calibre who has had business experience combined with sales experience in phenolic laminated products. If you are interested and feel you qualify, please write in confidence to: Box 12355, Modern Plastics.

OUTSTANDING OPPORTUNITY for Mechanical Engineer. Age 25-35. Aggressive and growing California Plastics Manufacturer, located in one of America's outstanding residential communities, has opening for M. E. graduate. Must be experienced and interested in machine and tool design, production tooling, as well as product development and experimentation. Experience in plastics extrusion highly beneficial but not essential for the aggressive young man needed. All details of education and experience requested in reply. Reply Box 11555, Modern Plastics.

CONSULTANT (Vinyl Polymers) Well established alkyd resin manufacturer wishes to expand into polyvinyl acetate emulsion field. Wants experienced chemist with production background as consultant. Location upper New York State. All replies held in strict confidence. Submit complete information and fee desired. Reply Box 12855, Modern Plastics.

CHEMICAL OR MECHANICAL ENGINEERING GRADUATE: Must have experience in extrusion and vacuum forming of thermo plastics. Reply Box 13755, Modern Plastics.

CHIEF ENGINEER—PLASTICS. Established company, experienced. Full responsibility for all engineering operations including mold design, tool estimating, placement of tooling, fixture and machine design, development of manufacturing techniques, and product development for injection molding. Vacuum forming experience helpful. Large operation—salary open. Confidential—let's talk it over. Reply Box 10155, Modern Plastics.

DEVELOPMENT CHEMIST—Large Midwestern manufacturer of vinyl, pyroxilyn and coated fabrics has good future for experienced man. Age 30-36, salary commensurate with experience. Reply Box 12655, Modern Plastics.

SALES ENGINEER—Large Mid West injection molder wants experienced men to call on custom molding industrial accounts. Small and large castings—engineering, tool rooms, vacuum plating, painting, hot stamping, silk screen and assembly. Quality, on time delivery and competitive prices. Permanent connection. Give details of territory and experience—our men know of this ad. Reply Box 10055, Modern Plastics.

CHEMIST OR CHEMICAL ENGINEER: Midwest injection, compression, and transfer molder requires person for research and development work involving materials and products. Excellent opportunity for advancement. Send complete resume, salary expected, and recent photograph. Reply Box 10755, Modern Plastics.

GENERAL SUPERVISOR fully experienced in Reed operation and all injection molding materials. New plant offering complete engineering, molding, and assembly facilities. Excellent opportunity at good salary for man looking for a young progressive company. Location, Bronx, N.Y. Reply Box 14055, Modern Plastics.

SITUATIONS WANTED

MANUFACTURERS' AGENT, Western New York State, selling Teflon and Kel-F products to Industrial, OEM, and Distributor accounts. Seeks one additional line, i.e., materials, injection and compression moldings, fabrications. Mechanical engineer, well established, references. Reply Box 12955, Modern Plastics.

VINYL CHEMIST: graduate engineer plus some post graduate; over four years experience formulation and production vinyl plastisols, vinyl solution coatings; plasticizer, resin and stabilizer evaluation; rheological studies and other special problems; also experienced formulation of other type industrial coatings; presently employed, seek career position with reputable firm, preferably NY-NJ area. Reply Box 12155, Modern Plastics.

PLASTICS ENGINEER M.I.T. graduate—age 30—6 years experience fabricating reinforced plastics products wants broader opportunity with progressive concern. Has engineered and managed all phases of production. Experienced in bag-molding, hand layups, Marco molding, fiberglas mat making, laminating with fiberglas mat and press molding. Specialist in development of processing equipment. Reply Box 11655, Modern Plastics.

MANAGEMENT OR MANUFACTURERS REPRESENTATION wanted by energetic, personable engineer with ability to produce results. Thirteen years: development, design, production and sales. Extensive knowledge of matched metal molding of reinforced plastics, honeycomb structures, adhesives, polymerization, etc. Chemical Engineer (BSE), Mechanical Engineer (MS). Los Angeles resident. Reply Box 13655, Modern Plastics.

ENGINEER—18 years experience in compression, transfer, injection, extrusion. Steering wheels, pipe and fittings, skate wheels, laminates, fiberglas molding. Vinyls, phenolics, styrene copolymers. Compounding, designing, production set-up, cost quotation, selling, research. Conscientious, cooperative hard worker. Able to set up and administer development and production of new products. Reply Box 12255, Modern Plastics.

CAPABLE ENGINEER of foreign nationality, age 35, married, with sound knowledge of Plastics in all branches seeks employment in U.S.A. as designer in plastic factory. 15 years experience including 7 as Works Manager. First class references. In case of engagement, a guarantee of employment will be necessary to enable applicant to enter U.S.A. Reply Box 12755, Modern Plastics.

PLASTICS CHEMIST—Available for consulation. Thoroughly experienced plastisol, organosol, and vinyl resin formulation for coated fabrics, calendered film and sheeting. Write box 11355, Modern Plastics.

MISCELLANEOUS

POSITIONS FOR PLASTICS EXECUTIVES—$5,000-$50,000
The nation's largest executive agency presents an exclusive service for men in the plastics and allied industries. This is a confidential, professional and rapid service for the nation-wide placement of successful men under 45 in the engineering, technical, sales and administrative fields. Send a short resume including age, education and work history and we will tell you by return mail what we have available for you and how we can help. Write to H. Graebner at GRAEBNER'S PLASTICS EXECUTIVE EXCHANGE, 116 South Michigan, Suite 705, Chicago 3, Illinois.

INTERESTED IN PURCHASING: Dimethyl Phthalate, Diethyl Phthalate, Tricresyl Phthalate, Ortho-Nitrobiphenyl, Ethox Methox, Di Carbitol, Pycal 94. PEERLESS CHEMICAL CORP., 181 Greene Street, N.Y.C. 12.

ESTABLISHED MANUFACTURERS' AGENT selling processed materials to diversified industries in New York State (exclusive of Metropolitan area) wishes lines of cements, adhesives, cohesives, etc. and other chemicals, for industries such as: furniture, cameras, sporting goods, leather goods, belts, automotive trimmings, optical goods, shoes, paper, rubber products, felts, combiners, impregnators and others. Reply Box 13155, Modern Plastics.

IMPORTANT ANNOUNCEMENT
British Xylonite Co. Ltd. (Cascelloid Division), Abbey Lane, Leicester. E. Shipton & Co. Ltd., Ferndown Works, Northwood Hills, Middlesex. Industrial Appliances Ltd., 21/22b Grosvenor Street, London W.1. Hereby announce that the plastic bottles and other flexible containers, and atomisers therefor, which are manufactured and supplied by the above Companies are manufactured under one or more of the following British patents and patent applications: 516,262. 667,163. 674,694. 680,808. 680,815. 698,418. 700,984. The use by any other person or Company of the inventions forming the subject of the above patents constitutes an infringement thereof.

WE ARE BABY PRODUCTS MANUFACTURERS, selling every leading jobber in this field. We wish to contact mfgs. having either stock molds of Baby items or products available for exclusive distribution to this trade. Reply Box 10655, Modern Plastics.

PARTNER WANTED. I have a patented machine in production making polyethylene bottles (squeeze bottles). I need capital—$15,000-$25,000 to proceed in this wonderful proposition. Applicant must be experienced salesman. Reply Box 13255, Modern Plastics.

All classified advertisements payable in advance of publication

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Up to 60 words $10.00	Up to 120 words $20.00	Up to 180 words $30.00
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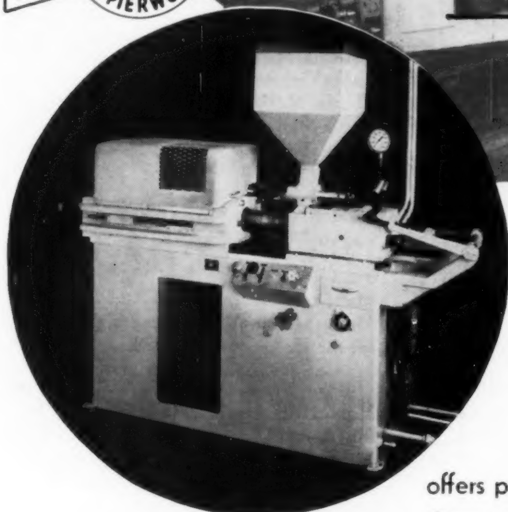
for further information address Classified Advertising Department, Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y.



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Fully Automatic Molding

FOR GREATER ECONOMY . . . SPEED . . . SAFETY

at Unbelievably Low Cost!!

The Standard Pierwood Automolder

offers positive mold protection against closing on unejected parts. One 15 hp. motor operates three machines with Vickers pump and control valves. Complete, positive and simple mechanical controls. No timers necessary.

1½ oz. Capacity
1200 Shots per hour
30 lbs. per hour
9 x 10 Mold space
12¾ Daylight
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MOLD COST
MAINTENANCE
LABOR COST
POWER CONSUMPTION
REJECT PARTS

Saves Time
Increases Capacity
Saves Material

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Foreign Representatives
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Kavanagh Sales, Inc.
New England Representatives
75 Water Street, Leominster, Massachusetts

Fred C. Ziesenheim
523 King Avenue
Marion, Ohio

Standard Tool Co., A. F. Cossette, Rep.
507 Fifth Ave., New York, New York

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DESIGNERS AND BUILDERS OF MOLDS FOR PLASTICS FOR FORTY-THREE YEARS

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INDEX OF ADVERTISERS

JANUARY, 1955

MODERN PLASTICS
575 MADISON AVENUE · NEW YORK 22, N.Y.


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Roller Bearing Axle
Company.

Main Office: 3100 to 3110 North Second St.

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- 1 -

WHAT THEY SAY.

WEIGHT 8150 Lbs.

WALDBERG BREWING CO.

TIMKEN ROLLER BEARING AXLES.

- 2 -

TIMKEN ROLLER BEARING AXLE

ORDINARY AXLES.

TIMKEN ROLLER BEARING AXLES

- 3 -

FORMERLY

TWO HORSES
Were required to pull this Surrey.

NOW

ONE HORSE
Can pull this Surrey by the bit.

- 4 -

COPY.
BUCKEYE BUGGY CO.

(Signed) Buckeye Buggy Co.,

COPY.
KNIGHTSTOWN BUGGY CO.

Knightstown Buggy Co.

- 5 -

TIMKEN
Roller Bearing
AXLES

Reduce draft over 50 per cent.

Require oiling only twice a year.

Can be substituted for ordinary axles on old vehicles.

Can be used with any standard wheel, old as well as new.

Are mechanically perfect. No breakages. Practically no wear.

Are easily adjusted. No play. No rattling. No lost motion.

Are adapted to all vehicles from the lightest speeding wagon to the heaviest truck and railroad car. Best on earth for automobiles.

- 6 -

Do your horses play out?
Do you want to double their serviceable life?
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IF SO, EQUIP ALL YOUR VEHICLES WITH
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All First Class Carriage and Wagon Manufacturers and Dealers.

Write us for booklet "Saving the Horse"

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TIMKEN ROLLER BEARING AXLE CO.
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- 7 -

IT MAKES A HORSE LAUGH

To Equip His Vehicle with
TIMKEN ROLLER BEARING AXLES

BECAUSE
His work is made easy.
He can do double the work he could formerly.
His life-time is doubled.

HIS OWNER LAUGHS EVEN MORE

BECAUSE
The draft on his vehicle is reduced over 50 per cent.
The earning capacity of his vehicle is doubled.
He has the fastest vehicle if not the fastest horse.
He has to oil his axles only twice a year.

- 8 -

In terms of performance—

TIMKEN® bearings still give you more for your money than any other bearings you can buy

IN 1901, Timken® tapered roller bearings were used mainly in wagon wheels. They saved "horsepower", manpower, materials and equipment. They were the best bearings you could buy.

Today, 53 years later, Timken tapered roller bearings are used in thousands of applications. They *still* save horsepower, manpower, materials and equipment. And they're *still* the best bearings you can buy.

Why? Because we've never stopped improving Timken bearings. One example: we're the only U. S. bearing manufacturer that makes our own steel to control bearing quality every step of the way.

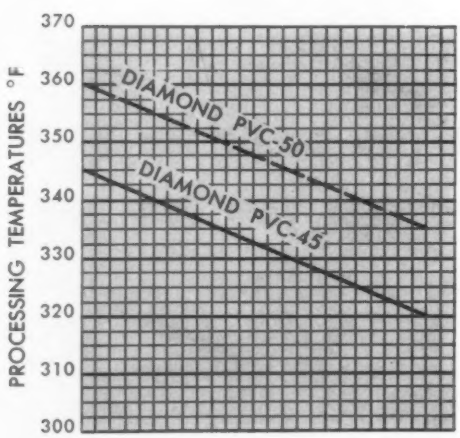
In terms of performance, Timken bearings *still* give you more for your money than any other make. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Chemicals you live by

Announcing Diamond PVC-45 for processing at lower temperatures



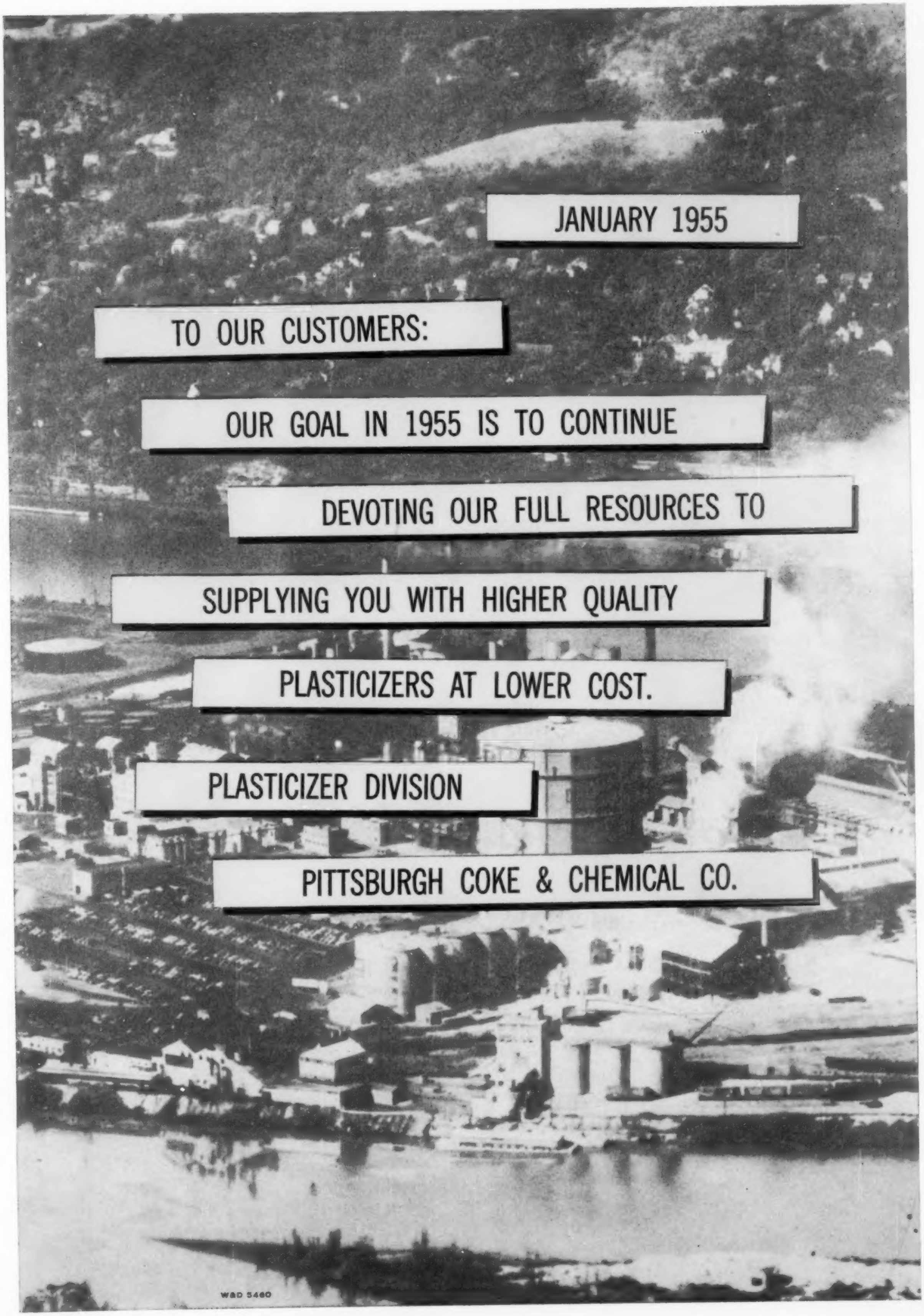
Processing temperature ranges for DIAMOND PVC-45 *and* DIAMOND PVC-50.

Out of DIAMOND research has come DIAMOND PVC-45, a new resin of medium molecular weight. It retains the high quality features of DIAMOND PVC-50; has the same particle size, moisture content and bulk density.

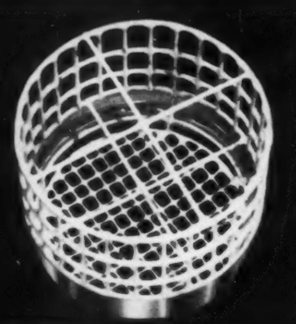
PVC-45 has good heat stability and absorbs plasticizer uniformly. It dry blends readily and fuses rapidly in molding, extrusion and calendering operations. Regardless of the process requirements, it will produce products with good color, clarity or gloss.

Review your processing problems now. See whether the easier processing characteristics, lower temperature requirements and shorter fluxing time of PVC-45, can save you money. Our technical staff will be glad to work with you. Write or call DIAMOND ALKALI Co., 300 Union Commerce Bldg., Cleveland 14, Ohio.

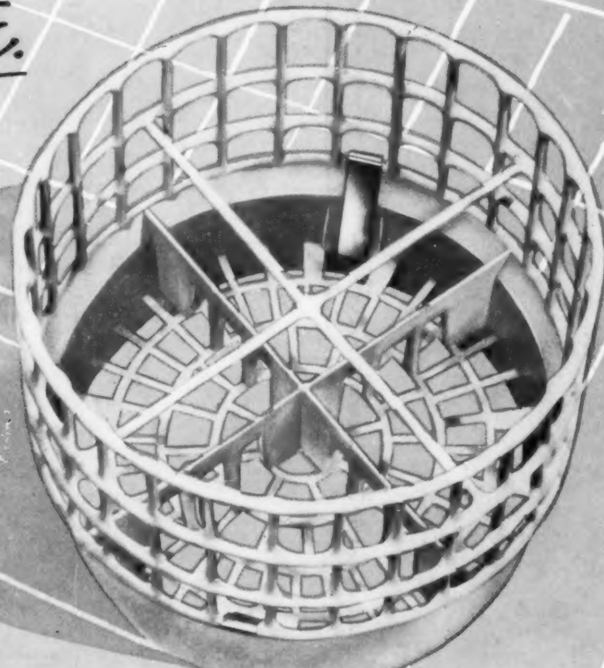
Diamond Chemicals


JANUARY 1955
TO OUR CUSTOMERS:
OUR GOAL IN 1955 IS TO CONTINUE
DEVOTING OUR FULL RESOURCES TO
SUPPLYING YOU WITH HIGHER QUALITY
PLASTICIZERS AT LOWER COST.
PLASTICIZER DIVISION
PITTSBURGH COKE & CHEMICAL CO.

How to make a good product even better (at lower cost, too) with plastics parts by G.E.



BEFORE:
Silverware holder—vinyl-covered wire . . . metal band around base



AFTER:
New design—molded nylon base . . . less expensive

BETTER PERFORMANCE AT LOWER COST! This silverware holder for an automatic dishwasher was originally designed as a two-piece unit using vinyl-covered wire and a metal band. Working with the customer, G-E plastics engineers redesigned the base as a single unit molded in nylon. **RESULT?** The following customer benefits: improved distribution of water for better cleaning . . . better positioning of silverware . . . smarter appearance . . . substantial cost savings.

Are you a large-volume manufacturer of parts or products?
If so, G-E plastics engineers would like an opportunity to help *you* improve designs, cut costs, add sales appeal to products. *Let's talk it over!*

Write: Plastics Department, General Electric Company, Pittsfield, Mass.
Plants at Decatur, Illinois—Taunton, Massachusetts 550-1A

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